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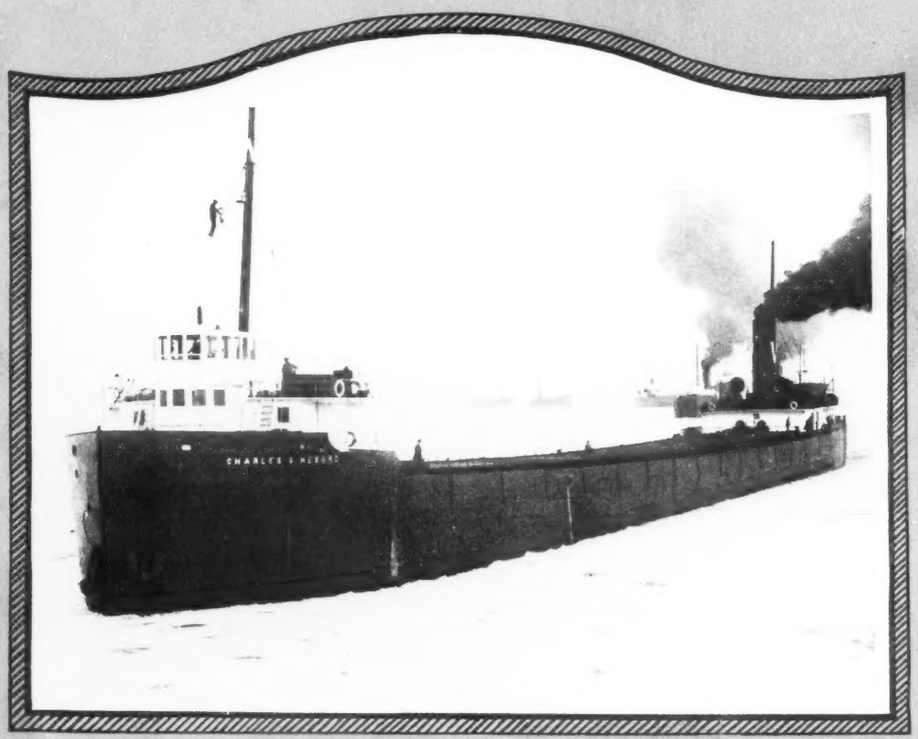

Ewing Galloway, New York

COAL AND ORE FREIGHTERS ON THE GREAT LAKES OFTEN BATTLE WITH ICE AT THE CLOSE AND THE OPENING OF NAVIGATION

World's Greatest Suspension Bridge Building Across the Hudson
R. G. Skerrett

Tanning Leather For Special Services
A. S. Taylor

Arid Lands Made Fruitful by Work of Bureau of Reclamation
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Erie Railroad Modernizes Its System
C. H. Vivian

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TO KEEP TONNAGE UP

~AND COSTS DOWN

The Westinghouse locomotive pictured is one of many used in the Elkhorn Division of the Consolidation Coal Company, on which NORMA-HOFFMANN Bearings are standards for replacement on the pinion end of the motor shaft.

"MECHANIZED MINING" will fall short of its full economic possibilities, unless the "wearing out" factor is minimized throughout the mechanical equipment.

Bearings, for instance:—if tonnage is to be maintained and costs kept down, the machine bearings must "stand the gaff," without distress or frequent failure.

The Consolidation Coal Company is one of many producers, operating on modern lines, who have found that NORMA-HOFFMANN Precision Bearings have the service-ability which reduces upkeep costs and contributes to larger production.

Both as original equipment, and for replacement purposes, NORMA-HOFFMANN Precision Bearings help toward higher tonnage and lower costs — because "they stand up."

TWIN PRECISION

Let our engineers aid you in modernizing your bearing equipment.
Write for the Catalogs

"NORMA-HOFFMANN"
PRECISION BEARINGS

NORMA-HOFFMANN BEARINGS CORPORATION STAMFORD CONN., U.S.A.

As It Seems To Us

PURE SCIENCE

HUMAN persistence, plus seven years of involved mathematics, and the carefully checked movements of a miniature apparatus of exquisite adjustment have determined the weight of this earth upon which we dwell. Dr. PAUL R. HEYL, physicist of the United States Bureau of Standards, in the interest of pure science, has thus ascertained that the inhabited globe represents an aggregation of 6,000,000,000,000,000,000,000 tons!

The so-called "cosmic scales" devised by Doctor HEYL and used in this research consist primarily of a bit of tungsten wire, one-thousandth of an inch in thickness, from which is suspended a little horizontal bar of metal. At each end of the bar is a solid glass sphere weighing 2 ounces, and in the middle of the bar is set a small mirror—the purpose of the mirror being to deflect a beam of light upon a very finely graduated scale. On opposite sides of the instrument are placed two 150-pound steel cylinders—the gravitational force exerted by these cylinders being sufficient to cause the bar carrying the mirror to swing slowly in a horizontal plane. The period of rotation of the bar, suspended in a vacuum, indicated under nicely controlled conditions the gravitational pull of the cylinders of known weight. This figure, after protracted and precise calculations, gave Doctor HEYL, at the end of the aforementioned period, the gravitational pull of the earth as a whole and, conversely, the total weight of the globe.

The man in the street need not concern himself about Doctor HEYL'S findings; and none of us will worry because the investigation shows the earth's density to be a trifle less than Sir ISAAC NEWTON calculated it to be. However, this more accurate determination of the earth's weight will be of value in various departments of research, and, among other things, in making certain astronomical calculations. It will also qualify computations in which the force of gravity plays a part—for instance, in the trajectories of projectiles fired from guns of one sort or another.

STAMPS BY THE BILLION

WHILE many departments of business are far from booming, still the United States Post Office Department is able to reveal some startling annual figures in the way of sales. For instance, the value of the postage stamps issued in a year approximates $467,000,000; and the amount of paper used in producing those stamps is 1,000 tons. If formed into a single strip, end to end, the stamps issued in the course of a year would be long enough to wrap around the earth ten times. It may satisfy some people to know that a year's output of stamps is sufficient to provide every man, woman, and child with 160 stamps. If these did not have to be paid for, wouldn't they be a boon for those that run riot in sending cards at Christmas and at other times throughout the twelvemonth!

To make the stamps stay put when duly dampened, they are coated on the back with a gum made from dextrine—really a tapioca starch. If all this dextrine were utilized, instead, in the production of a single gigantic tapioca pudding, there would be enough of this toothsome dessert to serve at a single meal a liberal portion to every dweller within the gates of the City of Greater New York.

The average annual output of postage stamps in this country amounts to 16,000,000,000. Of the total postal revenue for the fiscal year of 1930, so the *United States Daily* informs us, more than 80 per cent was derived from the sale of postage stamps and stamped paper. The cost of production is about one cent for every 125 stamps issued. Judged in this way alone, post offices would seem to be doing a pretty profitable business. Of course, we all know that there are other divisions of the work that more than eat up the profits made in the sale of stamps. However, the figures cited are interesting.

URBAN DRIFT OF POPULATION

ECONOMISTS have pointed out from time to time that farmers were handicapped by a shortage of labor resulting from the drift cityward of the country's rural population. This movement is understandable when we weigh the attractions offered there even by moderately sized organized communities, together with the generally greater range of occupational opportunities and the higher wages paid for services. The 1930 census discloses some figures bearing upon this subject.

The census of 1920 showed an urban population of 54,304,603 and a rural population of 51,406,017—that is, the urban population was greater than the rural by 1.4 per cent. In the succeeding ten years the urban population reached 56.2 per cent of the whole—a gain of 4.8 per cent. This figure, however, is susceptible of misinterpretation unless the basis for it be understood.

Previously, the Bureau of the Census has grouped under the term urban population all cities and incorporated places having 2,500 or more inhabitants. For the 1930 census the definition was modified so as to include townships and other similar political subdivisions with a total population of 10,000 or 1,000 inhabitants or more per square mile. Because of this change, numerous small communities ordinarily grouped as rural have become urban, and the populations so affected have been shifted in classification without any actual change of domicile. The point is, these particular communities are now altered in name because their citizens probably enjoy advantages that are not strictly attributable to *bona fide* rural or farm dwellers—amounting, in other words, to a penetration of the urban into sections heretofore grouped under the heading of rural.

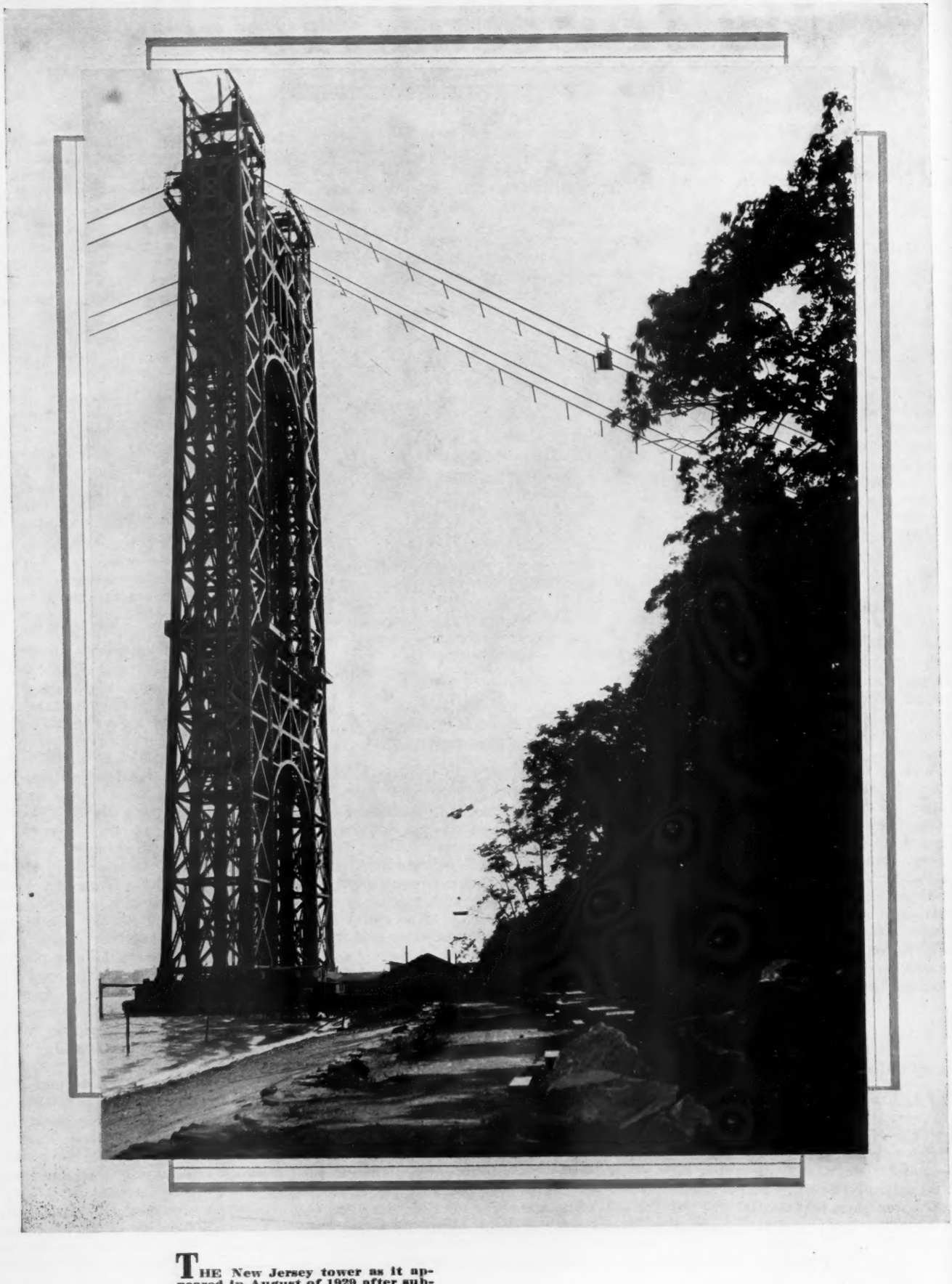
HELIUM IN AMERICA

IMMEDIATELY after the loss of the British dirigible *R-101*, much emphasis was laid upon the unwisdom of using hydrogen as a buoyant gas for airships of that general class, and once more attention was called to the superiority of helium because of the non-inflammability of the latter gas. Unfortunately, helium is not generally available the world over in sufficient quantities to supply the needs of lighter-than-air craft.

According to Mr. SCOTT TURNER, Director of the United States Bureau of Mines, there is no other country so favored as is the United States in the availability of large volumes of helium-bearing gases. While others undoubtedly have sources of helium, still they are relatively small when compared with those possessed by the people of the United States. As Mr. TURNER explains, developed resources of helium on a scale large enough to meet aeronautical needs are peculiar to this country.

The United States Government has a plant which has produced as much as 1,400,000 cubic feet of helium in the course of a month; and that plant is capable of turning out 2,000,000 cubic feet of the gas in a month. Unless discoveries change the situation, the United States will remain the only place in which a helium industry can be carried on on a sizable and practical scale. Even so, there are several cogent reasons why we should be careful to guard our preëminence in this matter. If dirigible airships are to form an essential part of our air fleets created for national defense, it is highly desirable that we husband our helium and see to it that none of it gets into the hands of those who may employ it against us.

Indeed, we can ill afford to be wasteful of our helium store, as it is an expensive commodity to recover from natural gas. Only recently news was broadcasted that the Government would, in the name of operating economy, hereafter dilute with hydrogen the helium used by our dirigibles—added evidence that we must conserve our supply of this incombustible and notably buoyant gas.



THE New Jersey tower as it appeared in August of 1929 after substantially 15,000 tons of steel had been assembled.

World's Greatest Suspension Bridge Being Built Across the Hudson

This Bridge Is a Magnificent Example of What Can Be Accomplished by Combining Engineering Skill and Constructional Resourcefulness

By R. C. SKERRETT

Perspective sketch of the bridge completed and viewed from the New York side of the river.

JUST where George Washington's military engineers placed batteries on opposite shores of the Hudson River to prevent the passage of hostile forces, the states of New York and New Jersey are now having built a great causeway high above the tide to promote the flow of vehicular traffic from the flanking shores of that historic stream.

The work in connection with this magnificent undertaking is directly under the supervision of the experts of The Port of New York Authority. Legislative acts of the two states concerned provided $10,000,000 to cover the early operations, but the project is being further financed by two authorized bond issues totaling $50,000,000—the bonds being issued by The Port of New York Authority. After Congress had approved the erection of the bridge, construction was started in May of 1927; and so rapidly have contributive operations advanced that the public is officially assured that the structure will be open to traffic early in 1932!

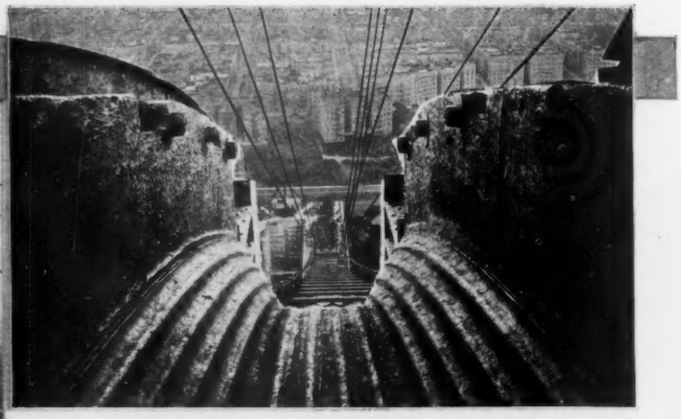
What progress to date represents in the way of a notable accomplishment can be grasped only after learning something about the stupendous magnitude of the bridge as well as about the vast scale on which some of the preparatory work had to be carried out. Less than four years ago there was nothing on either side of the river to indicate that the greatest bridge in the world was to have its two main towers set well-nigh on the sites where the cannon of Fort Washington on the east bank and those of Fort Lee on the west bank stood guard in the early days of our struggle for national independence. Today, those towers—fabricated of 40,200 tons of carbon and silicon steel, rise to a height of 592 feet above the water. In their final form, when faced with enveloping concrete and cut granite, the towers will be 635 feet tall. Hanging in graceful festoons from the towers are the four main cables of unprecedented size. These cables are secured on one side of the river to anchorages in bedrock and on the other side to an enormous block of masonry bound to the underlying rocky backbone of Manhattan.

WORK on the great Hudson River Bridge that binds New York City with neighboring New Jersey is going forward on schedule, and the structure will be so far advanced in the early part of 1932 that the upper deck can be opened to traffic. That auspicious occasion will mark the consummation of a project that has been urged in various forms for a goodly number of years. It will also mark the present climax in bridge engineering.

To date, the Delaware River Bridge, which links Philadelphia and Camden, is the next longest completed suspension bridge--being 1,750 feet between towers, while the Hudson River Bridge has a span of 3,500 feet. When first opened for service, the Hudson River Bridge will represent an outlay of $60,000,000; and the addition of the designed lower deck will call for a further expenditure of $15,000,000.

The length of the main span is 3,500 feet—twice that of the Delaware River Bridge, with two main cables, that links Philadelphia and Camden. The total length of the Hudson River Bridge between anchorages is 4,760 feet. Each of its main cables is a fagoted arrangement of 26,474 parallel wires, and each wire is 0.196 inch in diameter. In its finished state each cable has a diameter of 36 inches. If all the wires in the four cables were joined so as to form a single strand, that strand would have a length of 107,000 miles—in other words, be long enough to encompass the earth at the equator four times!

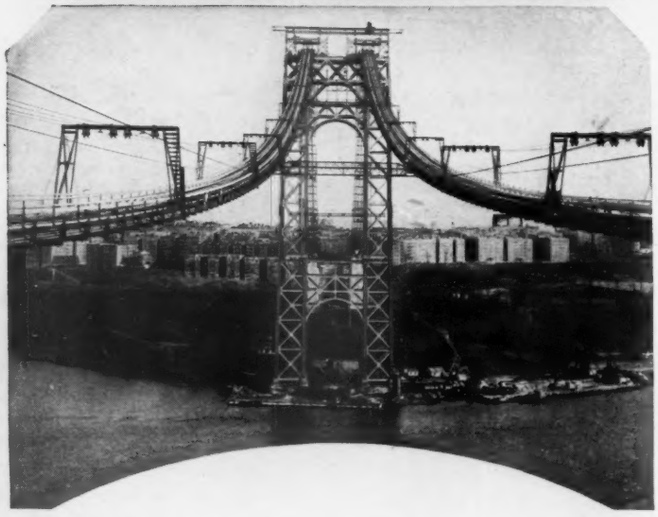
Before describing further the structural details of the Hudson River Bridge, let us deal with some of the outstanding preparatory work that had to be done in order to form the foundations for the towers and to provide the anchorages to which the main cables had to be tied so that the stresses set up by their own dead



Left—Looking eastward toward the New York tower from the footbridge erection cage, showing condition of work in September of 1929.

Right—Close-up of the south main-cable saddle on top of the New York tower.

Bottom—As the bridge appeared in November of 1929, looking eastward from the center span footwalk.



weights and the load of the suspended floor structure could be transferred to the solid rock of the Palisades at the New Jersey end and to the kindred formation at the New York end of the bridge.

The first step in this essential work was to clear the sites of overburden to expose the solid rock. In passing, it should be emphasized that these locations were determined only after numerous test borings had disclosed the exact geological character of the rock that was counted upon to bear the burdens of the towers. Many physical and other circumstances made it desirable to place the bridge where it now is, with its eastern end between 178th and 179th streets, in New York City.

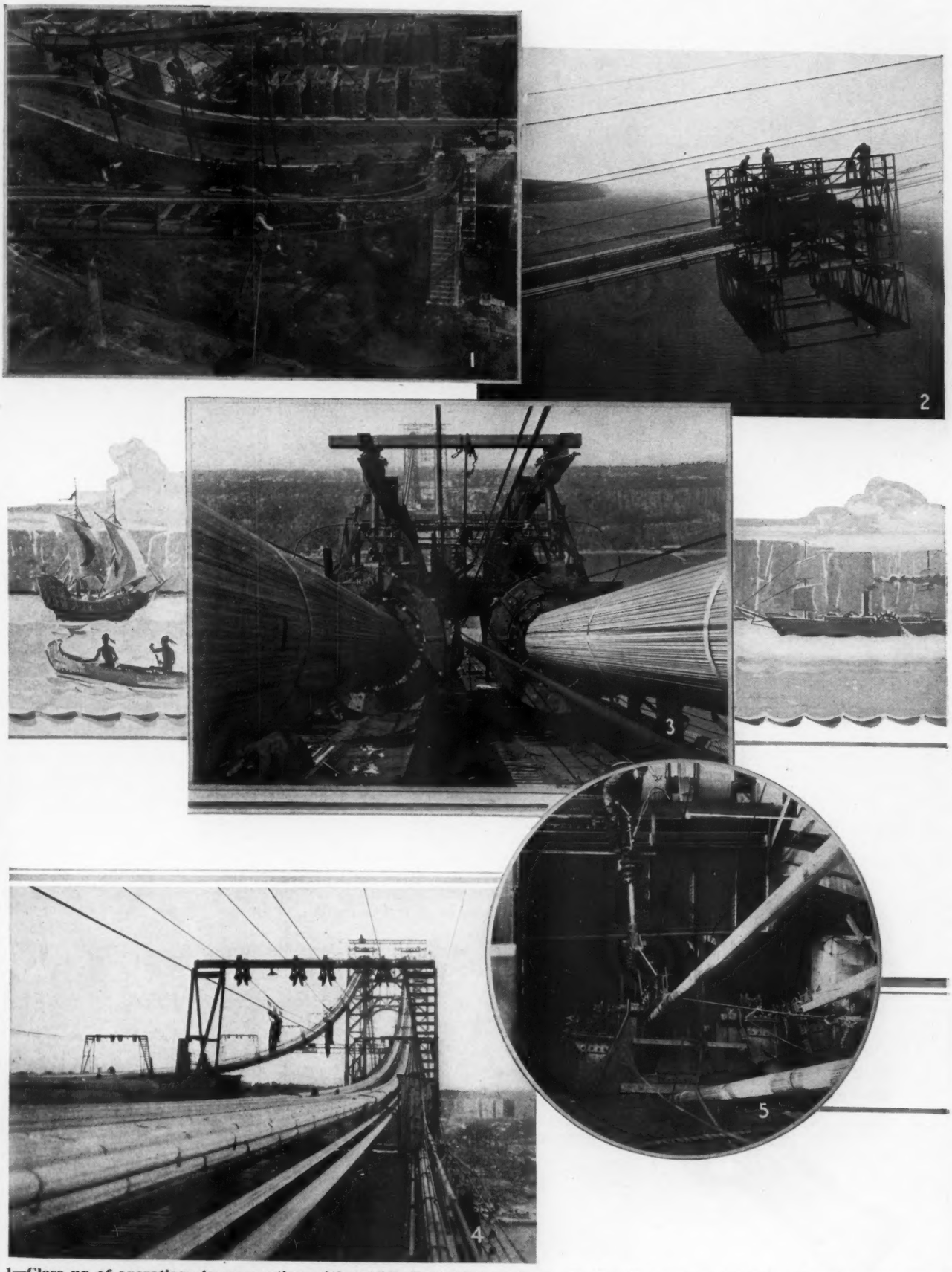
On the New York side of the river, because of favorable conditions, the foundation for the tower was built with its outer face at the water's edge and on rock that could be excavated within simple, shallow cofferdams. The contractor for the tower foundation on the New Jersey side had a far more difficult task. He was required to construct the supporting piers at a point offshore, just within the pier line prescribed by the Government engineers; and in order to reach bedrock it was necessary for him to sink two cofferdams to depths ranging from 35 to 79 feet. Not only that, but the cofferdams had to be securely braced and kept tight while resting on a rather steep slope of jagged rock. The contractor elected to do this work in open cofferdams instead of in pneumatic caissons; and his success is ample evidence of the courage, skill, and resourcefulness displayed in doing the unusual.

Mr. O. H. Ammann, Chief Engineer of The Port of New York Authority, thus described in the progress report of March, 1929, how this difficult work was done: "Briefly, the silt overlying the rock was first dredged out to a uniform depth about 45 feet below the surface of the water, and timber frames were sunk against which the steel-sheet piling, driven to rock, were supported. In the deeper portions of the cofferdams the sheet piling formed double walls, separated by cross walls forming pockets into which, as the case required, either concrete, sand, or silt was deposited. In the shallow portions of the cofferdams, where the hydrostatic pressure wa less, only a single wall of steel-sheet pilin was used. After the cofferdams were un watered, excavation was started in the shal low portions, and, as soon as a considerable area of the rock foundation was exposed concreting was started and carried to such an elevation as to encase the lower three tim bers of the frames. In this manner excavation and concreting proceeded step by step fro the shallower to the deeper portions—th concrete in each step being brought up t approximately the same elevation.

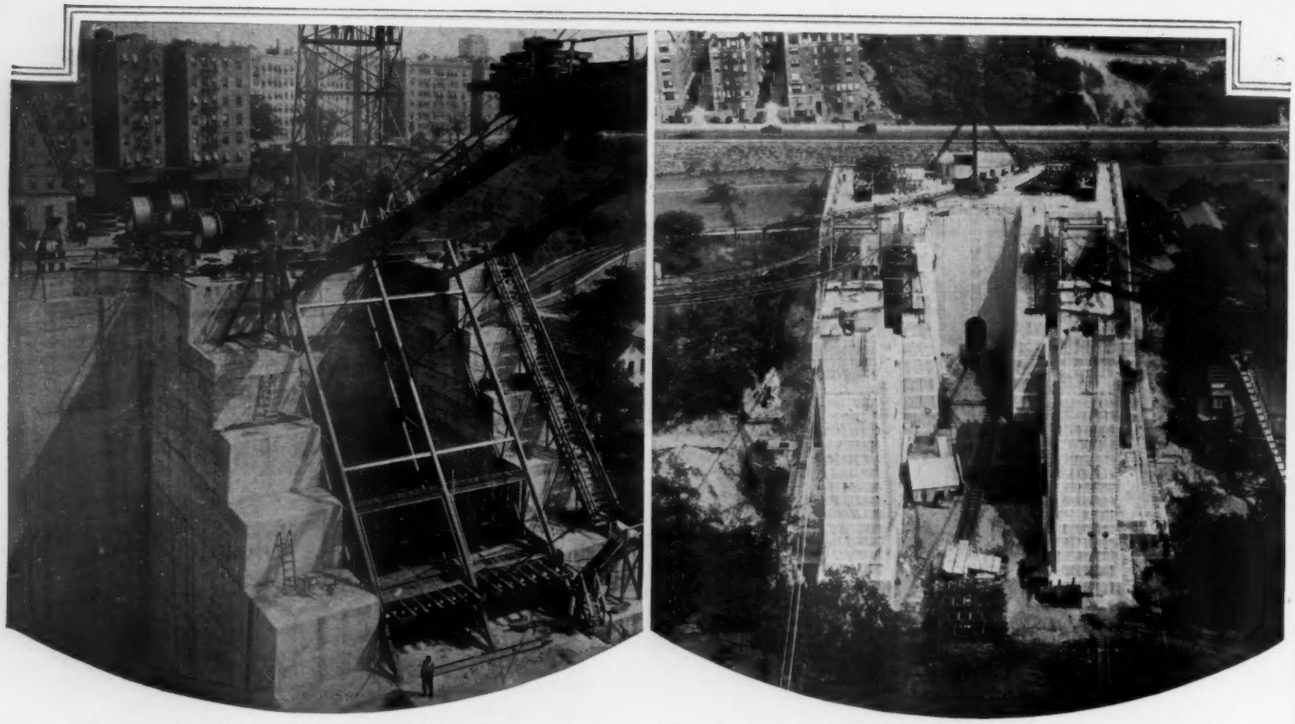
"Upon the removal of the overburden, th rock was found to be throughout of soli sandstone of varied degrees of hardness an texture, and of very rugged surface. Thi was a most fortunate condition because th natural steps or benches formed a most ex cellent bond with the concrete so that litt or no blasting of rock was required. The so overburden of silt was largely removed hy draulically by flushing it to the centrifuga pumps which had been installed to unwate the cofferdams and to remove any seepag into them. The seepage in both cofferdam was so light that the pumps had ampl capacity for removing the silt in this manne Directly above the rock a stratum of shell boulders, and disintegrated material wa found. These were removed by being loade by hand into skips or buckets which we hoisted out of the cofferdams by derricks an deposited outside of the cofferdams.

"After all excavation had been complete and the concrete over the entire area of th pier had been poured to such a level as to en case the lower three frames of timber, th operation of concreting was carried on con tinuously, all further timbers being remove as the work proceeded. About 9 feet belo the water level the granite facing was begun and thereafter all concrete was poured cour by course with the granite facing. The co tract for this work was executed on May 1 1927, with Silas B. Mason Company, In Work was started promptly thereafter an was completed and accepted June 8, 192 The contract involved 75,500 cubic yards dredging, the placing of 35,480 cubic yard of concrete, 1,400 cubic yards of granite, an 300 tons of reinforcing steel. The total co was $1,058,700."

There is a pier under each leg of each tow



1—Close-up of operations in connection with setting footbridge sections. 2—Erection cage engaged in attaching main-span footbridge sections. 3—Hydraulic compactors at work squeezing main-span cables to final size. 4—Spinning wheels passing one another on one of the main cables. 5—A cable strand being placed in an anchor-block saddle.



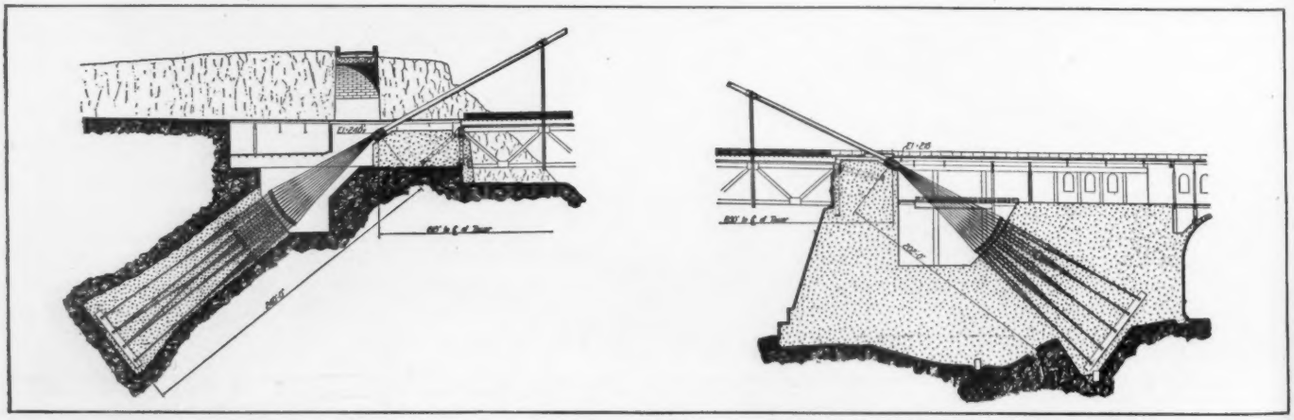
Left—Cable-spinning machinery on top of south anchorage on New York side. Right—New York anchorage in its entirety, photographed from top of neighboring tower in August of 1929.

The piers are 153 feet apart, center to center; and each has a horizontal cross section at the water level, exclusive of the granite facing, 76.5 feet long and 68 feet wide. The total masses of the piers, however, differ because of the amounts of concrete required to bring them up to a uniform level. Arthur McMullen Company, the contractor for the New York tower foundation, was obliged to place 9,700 cubic yards of concrete; and so expeditiously was the work done that it was possible to start the erection of the steel tower on July 1, 1928.

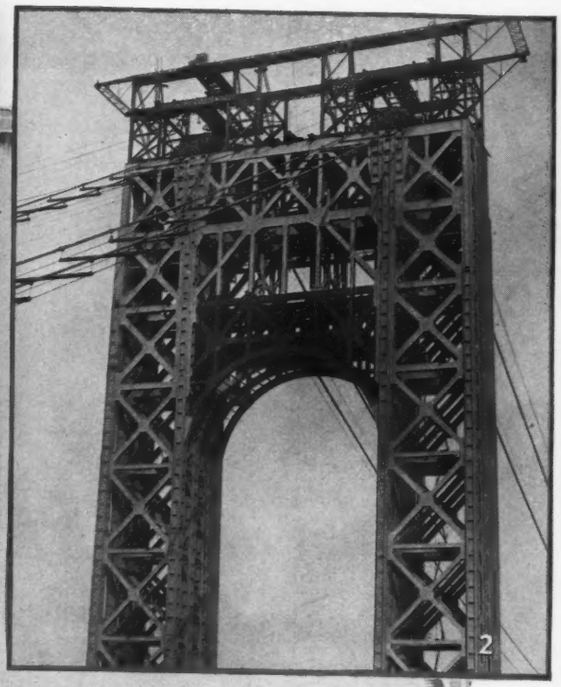
While spectacular in its proportions, still the anchorage for the Manhattan ends of the main cables presented no marked difficulties to the experts of the contractor, Arthur McMullen Company. The problem consisted primarily of clearing away the overburden and then of preparing the exposed bedrock for the pouring of the concrete that forms the main mass of the anchorage. In brief, the anchorage is virtually a gigantic block of masonry about 200 feet wide and 290 feet long at its base, with a height of 130 feet. It has been treated architecturally and now is an integral part of the imposing viaduct that spans Riverside Drive. In this mass of concrete are embedded twenty heavy girders, and to these are attached a total of 976 eyebars to which the strands of the four cables are secured. As a protection against corrosion, all steelwork in the anchorage was given three heavy coats of red lead before being enveloped by the concrete. The task in its entirety necessitated the excavating of 16,000 cubic yards of earth and rock; the setting of substantially 2,500 tons of anchorage steelwork in addition to approximately 500 tons of reinforcing rods; and the pouring of 110,000 cubic yards of concrete. That anchorage involved an outlay of $1,150,000; and, despite its great size, was completed three months ahead of schedule. This was due to the extensive and carefully coördinated material-handling equipment installed to expedite operations.

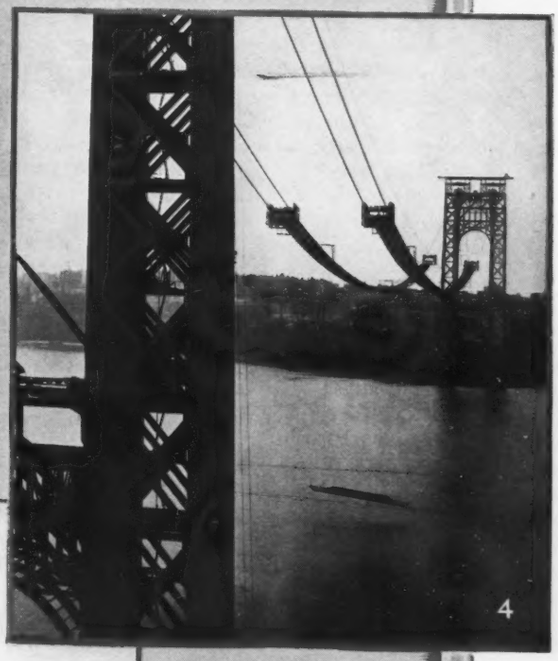
The contractor for the New Jersey anchorage and the bridge approach through the Palisades—Foley Brothers, Inc.—was required to excavate in hard traprock two inclined tunnels, a crosscut tunnel connecting them, and a vertical shaft tapping the northernmost limits of the crosscut. All told, a matter of 220,000 cubic yards of rock had to be excavated under this contract. The superficial rock cut extends inland from the end of the bridge for a distance of 750 feet and this approach is 146 feet wide.

While the approach work was in hand, the contractor sank the vertical shaft, 7x9 feet in cross section, to a depth of 250 feet; and from that northern point he drove the crosscut tunnel southward parallel with the river. In turn, from this crosscut he drove the two anchorage tunnels surfaceward, beginning at their lower ends. This procedure permitted the contractor to do this part of the work without interfering with the excavating of the

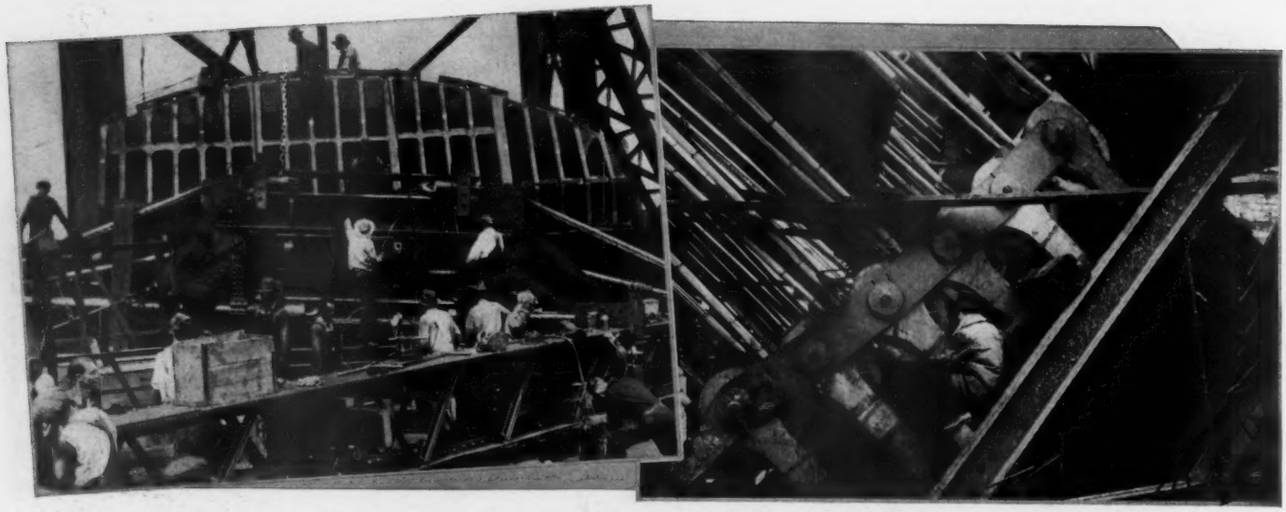


Left—Longitudinal section of New Jersey anchorage. Right—Longitudinal section of New York anchorage.





1—Status of work on main-cable footbridges in the early fall two years ago. 2—Close-up of top of New Jersey tower with construction crane in place. 3—Footbridges completed for the stringing and spinning of the main cables. 4—Hoisting a cross-bridge girder for stiffening the main-cable footbridges. 5—Progress of steelwork on floor structure near end of November of last year.



Left—Top of New York tower showing cable saddles and adjusting of the footbridge ropes. Right—Cable-strand connections at the New York anchorage photographed in April, 1930.

approach cut, and it enabled him to run the muck from the anchorage tunnels in cars, by gravity, to the crosscut, whence the cars delivered their loads, also by gravity, to a hoist installed in the vertical shaft. When the girders and eyebars were in place in the two anchorage tunnels, then those inclined pits were filled with concrete to bind the steelwork for all time with the enveloping rock. The New Jersey anchorages have, therefore, the weight and the strength of the Palisades to absorb any stresses set up by the four connecting cables.

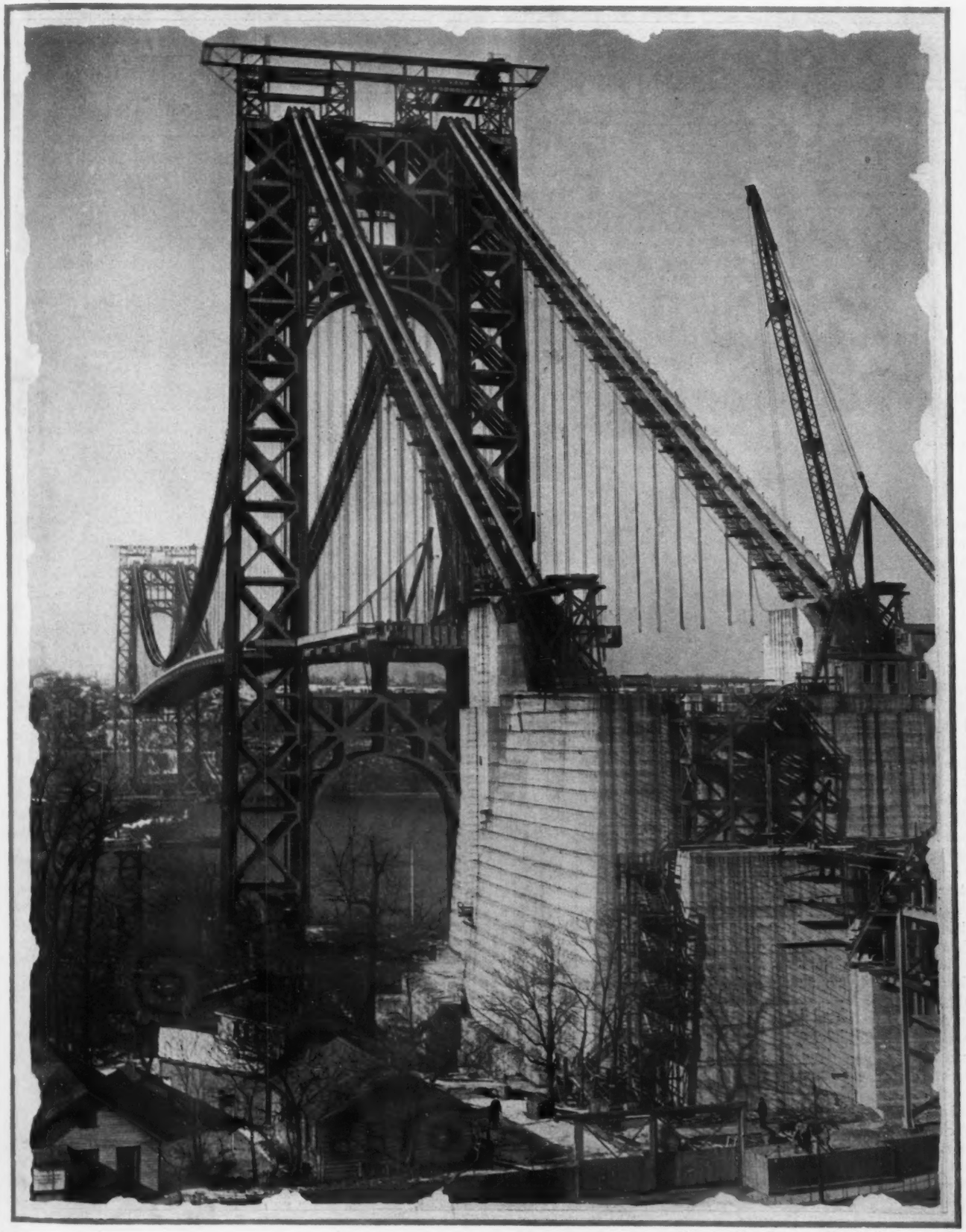
With the tower foundation finished, then the agile, seemingly nerveless erectors took over the perilous and exacting task of binding together the various steel units of the great towers. Of all the work done on the bridge, nothing has made a heavier demand upon human physical endurance and courage; and the finished towers now stand mute monuments to the men that made them possible. The contract for the fabrication and the building of the towers was signed early in November of 1927 with the McClintic-Marshall Company; and the first orders for materials from the mills were placed before the end of the year. Actual construction began in January of 1928. The fabrication of the lower half of the New Jersey tower was sublet to the Bethlehem Steel Company, and the corresponding work for the New York tower was awarded the American Bridge Company. The McClintic-Marshall Company fabricated the upper parts of both towers in its own shops.

Each tower is composed of twelve panels; and it was essential that the tops of the columns in each leg of each tower should be at the same elevation so that the saddles, which support the cables, should have their loads distributed uniformly upon them. Erection was stopped after ten panels were in position, and accurate measurements were then taken so that adjustments could be made in the succeeding two panels to provide the required uniformity. However, so accurate had been the work done to that point that the maximum difference in length between the highest and the lowest column in any of the four legs of the two towers was only 3/16 inch, and, vertically, the variations were negligible. Even so, this relatively minute difference was corrected. What this achievement represented in nicety of workmanship can be better understood when one is reminded that more than 15,000 tons of steel was put together in each tower which, at the time of measuring, reached a height of about 500 feet. In erecting each tower, the men aloft had to drive more than 500,000 rivets! For the sake of safety, work on the towers was halted during the winter months of 1928-29; but as soon as weather permitted, operations were resumed in 1929 and the towers completed in June of that year.

The contract for the cables, suspenders, and anchorage steelwork was awarded the John A. Roebling's Sons Company on November 4, 1927; and it required that the anchorage steelwork for the New York end of the structure should be delivered at the site by April 1, 1928. The contractor was also called upon to have the corresponding steelwork for the New Jersey anchorage on hand when needed at that point. The first heat of metal to be used in the wire cables was taken from the furnace on January 24, 1928; and the first wire for the cables was drawn about 30 days later. Preparatory to stringing and spinning the wires and the cables, the contractor's forces were engaged for quite five months in assembling the plant for that work at the bridge. The first wire for the first cable was strung across the Hudson in October, 1929, while the last wire of that cable was spun on July 28, 1930. The last wire of the fourth cable was spun on August 7, following.

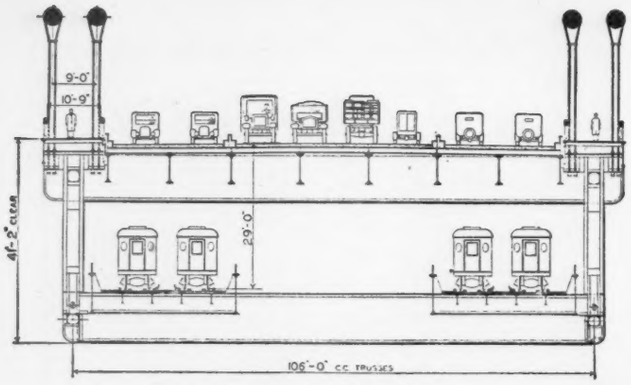
We should like to detail the really wonderful work done in connection with the stringing of the wires and the final assembling of the main cables—each of which consists of a group of 61 separate strands each made up of 434 wires. Space, however, does not permit. The system employed by the contractor was such that he fabricated and completed four cables in the time originally set for the finishing of two cables. When all the strands for a cable were grouped they were encircled by a "squeezer" equipped with twelve hydraulic jacks, each of which could exert a pressure of 30 tons. The squeezer compacted the 61 strands, which were then bound with metal straps. Upon completion, each main cable had a diameter of substantially 36 inches—4 inches greater than that of the cables of the Delaware River Bridge. The wire for the cables was made of high-grade steel by the "cold-

Approach arch over Riverside Drive, New York City, about ready for the placing of the concrete.



Keystone View Company, New York

THIS picture of the Hudson River Bridge was taken at the close of last year and just after the first of the floor steelwork spanned the river.



TYPICAL CROSS SECTION

drawn" process; and each wire was coated with nearly pure zinc to safeguard it against corrosion.

Before the main cables were strung and spun, two working platforms were hung between the towers to serve as footbridges for the cable spinners. These footbridges were each 25 feet wide and tied by cross bridges that facilitated operations and incidentally stiffened those platforms against lateral movement. Each footbridge was held aloft by two groups of nine twisted wire ropes of 2⅞-inch diameter. These ropes were afterwards cut into lengths that would serve as permanent suspenders for the floor of the bridge.

When completed, the floor will have an upper and a lower level. The upper level will have two sidewalks and driveways for eight lines of vehicles, and the lower level will carry four lines of rapid-transit cars. When opened to traffic, next year, the upper deck will have only four of the vehicular roadways ready; and at that time the bridge will represent an expenditure of $60,000,000. To equip the bridge for its maximum designed capacity will call for an additional outlay of $15,000,000. As we go to press, the massive floor beams of the upper deck have been attached to the suspenders and tied together longitudinally by stringers so that the main framework of the upper deck binds New Jersey and New York by another steel tie. This steelwork will serve as a great working stage for the "flooring boys" who will place and connect the rest of the metal fabric.

While Mr. Ammann has stated that the Hudson River Bridge is merely a step farther in the application of well-established principles and theories as well as in the utilization of familiar materials and means and methods of construction, still the bridge would not be as it is today, after little more than three years of work, had not special machinery and ingenious apparatus been devised and built to facilitate ponderous operations and to speed up work while adhering to a high standard of precision. Similarly, testing and inspecting have been aided by a very well equipped laboratory that makes doubly sure that all materials are of the best.

With the upper and lower levels of the floor in position, there will be a clearance of 213 feet between the underside of the span and the surface of the river—ample headroom for the greatest of passenger or fighting ships afloat today. Traffic and revenue studies indicate that the bridge will amply justify itself when available for service. It will form an important link in a comprehensive system of highways planned to facilitate transportation within the Port of New York, and it will also connect numerous tributary national highway routes.

A part of this vast and manysided undertaking, about which we cannot now speak, is the work that has to do with the approaches that have been skillfully designed and in a measure prepared so as to make it possible for the various streams of traffic to reach and to leave the bridge without confusion or risk. The arrangement is virtually an arterial system of seeming complexity but, withal, one of astonishing simplicity. Indeed, in every particular, the bridge, with its associate features, is a magnificent example of engineering skill and constructional resourcefulness.

In addition to the contractors already mentioned, the demolition of buildings at the New York approach has been in the hands of the Klosk Contracting Company; the Cornell Contracting Corporation has been engaged on the main approach ramp on the New York side and on the vehicular tunnel in connection with that approach; and George M. Brewster & Son, Inc., have had 80,000 cubic yards of traprock to excavate in clearing the way for the approach at the New Jersey end of the structure.

In the department of engineering, various phases of the project have been looked after by the following personnel: O. H. Ammann, chief engineer; E. W. Stearns, assistant chief engineer; Allston Dana, engineer of design; J. C. Evans, terminal engineer; and Montgomery B. Case, engineer of construction. The consulting organization has been composed of the following engineers: William H. Burr, Daniel E. Moran, Joseph B. Strauss, Leon S. Moisseiff, Lewis Buckley Stillwell, and Ole Singstad. The consulting geologist has been Prof. Charles P. Berkey; and Cass Gilbert has served as architectural consultant.

METALLIZED WOOD

METAL-wood is the newest thing in building materials, reports a foreign correspondent of the American Chemical Society. It is the product of a German, and is nothing more nor less than wood impregnated with low-fusing-point metals such as lead, tin, or alloys.

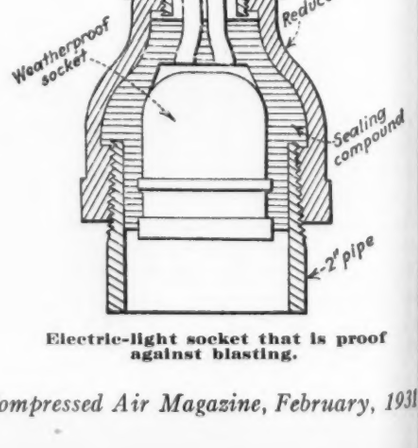
By the process worked out at the Kaiser Wilhelm Institute for Iron Research, at Düsseldorf, the canal systems and the medullary rays of the wood can be filled either entirely or in part with the desired metal. This is done, first, by immersing the wood in the molten metal after it has been dried as much as possible and, then, by subjecting it to moderate pressure in a closed vessel.

While retaining all the characteristics of the untreated commodity so far as workability is concerned, the metallized wood is said to possess greater density and has little tendency to swell and to burn.

BLASTPROOF SOCKETS FOR ELECTRIC LIGHTS

FOR efficient mine operation, electric lights must frequently be used at locations where there is more or less blasting, writes Don Daboll of Ray, Ariz., in the *Engineering and Mining Journal*. Examples of such places are tipple sites where boulders are blasted on pocket screens, and loading stations where *débris* is occasionally blasted from chute or hopper doors. Sometimes the lights in such places can be protected by installing them behind steel column I-beams or other structural members; but usually, because of objectionable shadows involved, other methods of protection must be employed. Where comparatively little light is needed, an extension cord or two may be so arranged that cord and light can be moved to a safe place before blasting. When more lights are needed, drop cords with plugs may frequently be installed to advantage. These two methods, however, though easily adopted, are not altogether satisfactory for the reason that bare spots and short circuits develop in the cords and because the plugs and receptacles become damaged and fouled.

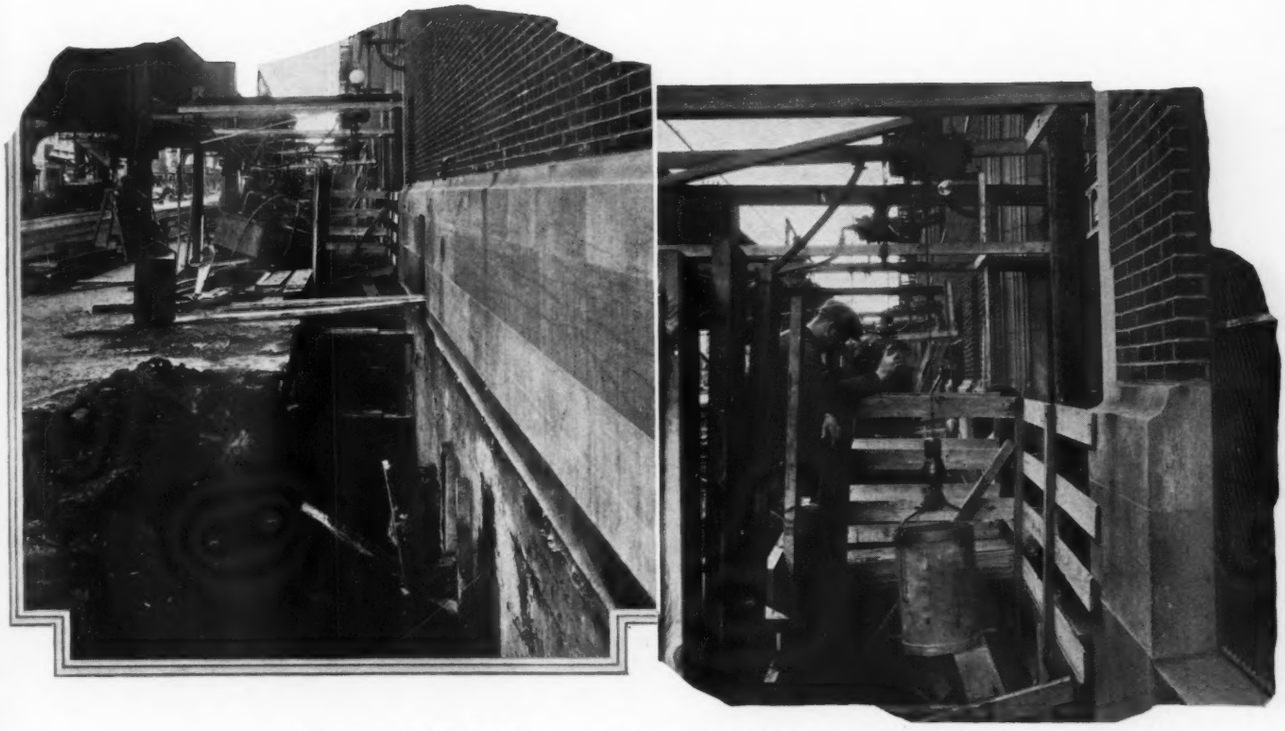
A less troublesome way of dealing with the problem is to use blastproof sockets, conduits, and heavy junction boxes, instead of the regular knockout boxes. The blastproof sockets, which are made of pipe fittings as shown in the accompanying drawing, are screwed into the covers of the boxes. With this arrangement only the lamps need be removed before blasting. When properly made, sockets of this kind will withstand severe blasts.



Electric-light socket that is proof against blasting.

Air Hoists Handle Muck With Dispatch On Underpinning Job

By O. J. SMALL



Line-up of air hoists along the Fulton Street side of the schoolhouse.

THE subway builder in crowded cities like New York and Brooklyn hasn't an easy time of it. There are so many obstacles in his path that cannot be avoided: they must be overcome each in its own particular manner. Underlying the streets are sewers, water-supply mains, gas pipes, and conduits carrying telephone, electric light, and power lines, all forming a veritable network along the right of way that must be dealt with carefully lest danger be invited or service be interrupted and industry and the householder inconvenienced. But there are still other difficulties that confront him.

Not infrequently it happens that the substructures of flanking buildings interfere, or the route runs close to or even under the buildings. This means that before excavating at those points can be finished the foundations of the structures affected must be underpinned either in part or entirely, as the case may be, so as to support them and safeguard them against subsidence and possible damage. This work is usually handled by specialists—contractors or individuals that have had much experience in this field.

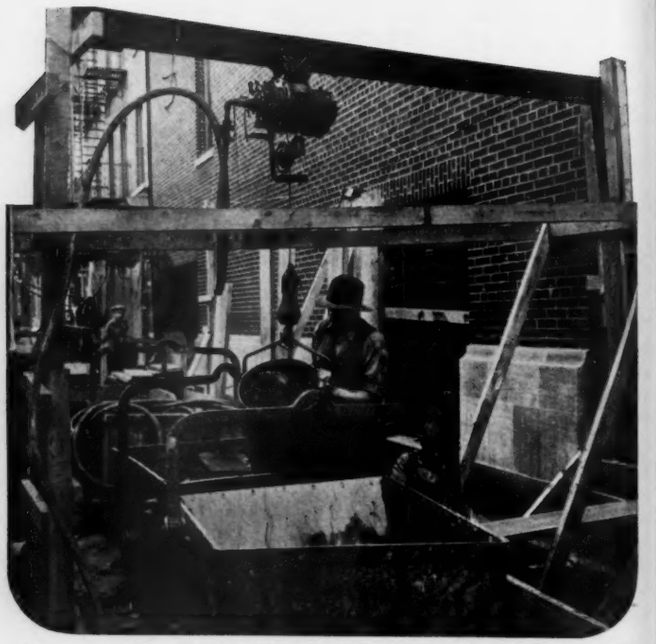
In the case of a certain subway section now in course of construction under Fulton Street in Brooklyn, the contractor has to provide for the strengthening and the underpinning of all the buildings that were left standing on either side of the line. But this is not all. He is called upon to give firm footings to numerous columns that support an elevated railway running through that downtown thoroughfare which, normally, is a very busy one. Obviously, this phase of the essentially preparatory operations must be done with the utmost dispatch if contract schedules are to be kept, and, therefore, machinery is pressed into service wherever practicable to save time and labor.

During the early stages of the underpinning along the section under consideration, the subcontractors were handling excavated material by means of buckets that were raised and lowered manually by ropes running over sheaves. While this time-honored method of hoisting might do well enough on a small job it was not adequate in the present instance, as the work involved considerable digging and mucking at many separate places throughout a fa rly long stretch. As the subway is being built from 60 to 70 feet below street level, it is necessary on occasions to go down still farther in order to properly strengthen adjacent foundations—the excavations for the underpinning being carried to depths ranging anywhere from 35 to 80 feet. It was soon apparent that something more up-to-date in the way of handling spoils was desirable if the progress made by the muckers was to be maintained. As a result the sheave has given way to the air-motor hoist; and the man that pulled the rope no longer has to exert any physical effort to bring up the load. He just operates the controls of the hoist that does the raising and the lowering of the bucket for him.

Numerous hoists of this kind are now in use alongside a large schoolhouse and other buildings, elevated columns, and wherever else underpinning is going on, and they are doing much to expedite the removal of the excavated material. They are capable of lifting 250 pounds each; and are of the Ingersoll-Rand single-line long-lift AX Class which ranges in capacity from 250 pounds to 10 tons. This is a standard type of air-motor hoist provided with a special drum for taking on more than the average length of cable.

The hoists are equipped, as the accompanying illustrations show, with ball-bearing trolley wheels so that they can be run along I-beams. These beams are mounted variously, depending upon the working site. Where buildings are concerned, they extend at right angles from the wall directly over and beyond the several excavations so that the loaded buckets, as they reach the surface, can easily be run along their respective beams for emptying. The buckets travel at a rate of approximately 120 feet a minute and hold 2½ cubic feet of earth each. This is dumped into more capacious stationary buckets which, when full, are picked up by a large

Getting ready to underpin an elevated-railway column.

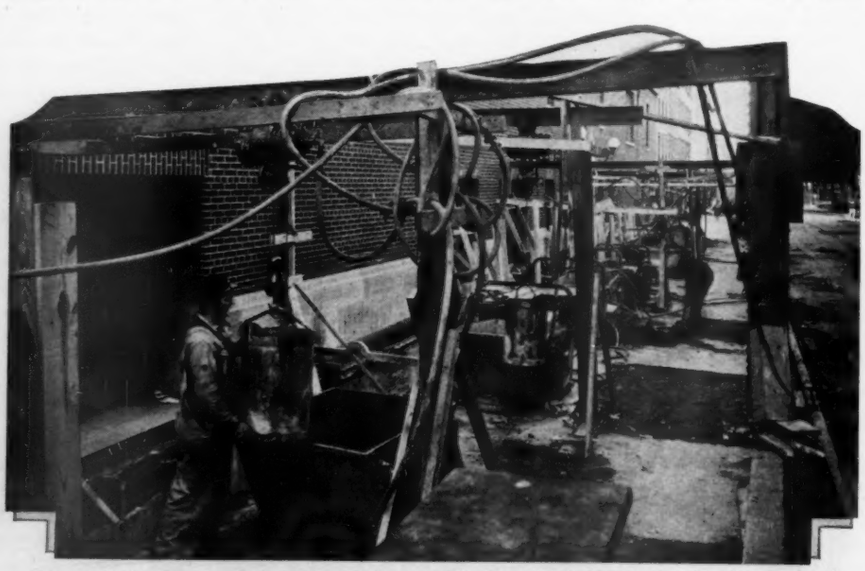


Close-up of one of the hoists showing mounting arrangement.

crane and discharged into waiting trucks. In the case of the elevated columns, the spoils are sometimes loaded into bins or chuted to one side for subsequent removal.

Since the excavated material has been handled by means of air hoists, the work has moved along much faster and far more smoothly than in the beginning. In fact the contractors claim that, as a result of the change, they can bring up not only three times as much muck in one lift but raise it in less than half the time required to hoist a load by the older method. They figure that, as compared with earlier performances, each hoist is saving them approximately $30 a day. With many hoists on the job, this, as can readily be seen, will soon run up into money.

The underpinning operations are being done by the Carleton Company, Inc., of New York City, and the International Engineering Company of Brooklyn; and the air for the hoists is supplied by several compressor plants, including both stationary and portable machines, primarily installed at different points along the proposed route to furnish air for rock drills, clay diggers, and other pneumatic equipment used in the building of the subway.



Some of the many air hoists used in handling excavated material in the work of underpinning preparatory to subway building.

A newly discovered deposit of quicksilver is being developed in Japan that yields ore which is said to compare favorably with that mined in Spain, a source of much of the world's supply.

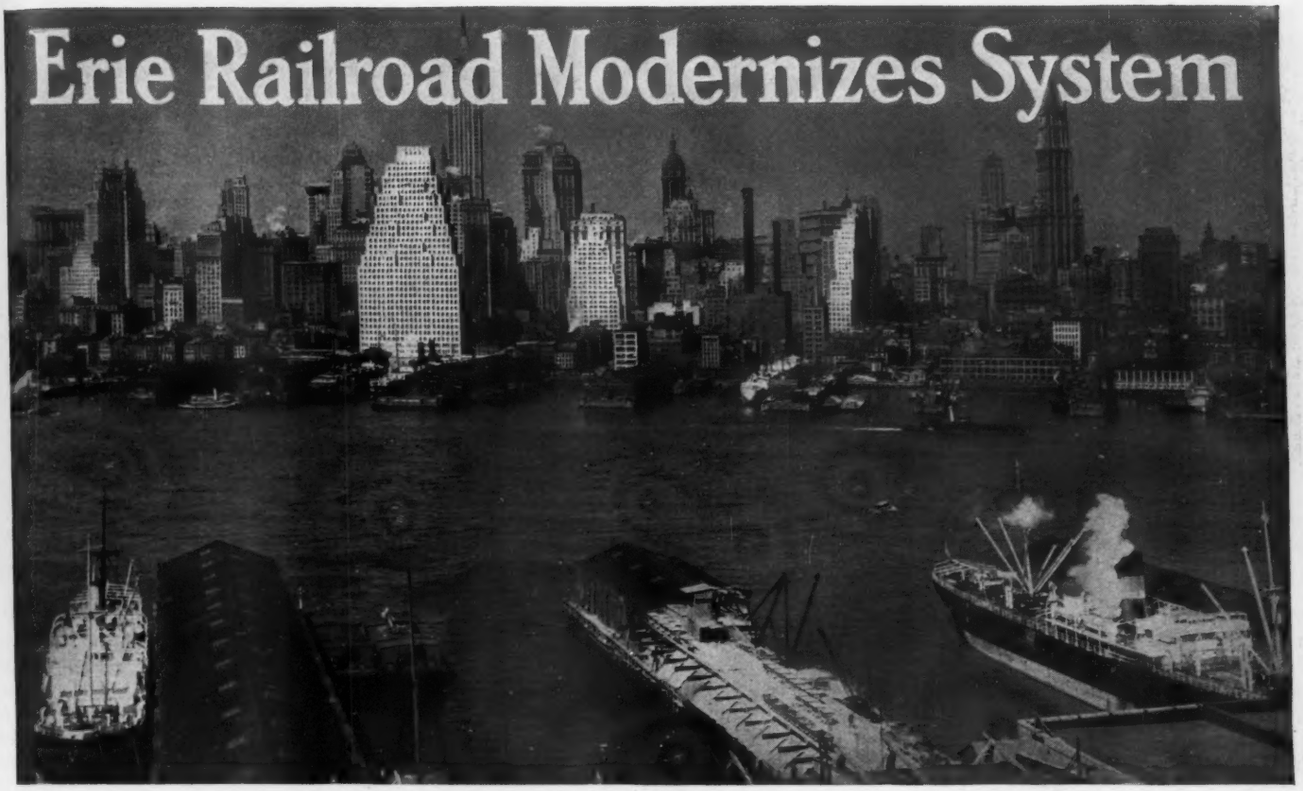
ICE FOR SHIP SALVAGE

USING water to keep out water sounds paradoxical, but we have it on the authority of the London *Engineer* that a German technicist, Mr. W. Kiwull, conceived and experimented with the idea of sealing leaks in the metal hulls of ships with blankets of ice. That his idea appealed to the imaginative is evidenced by the fact that he succeeded in forming a company which has planned and has had built a compound ammonia compressor plant that has been undergoing preliminary tests in Switzerland.

The specifications called for a compact, sturdy, portable refrigerating plant that would be adaptable for use on shipboard; at all times immediately available for operation; and reliable in its functioning even when unattended. The unit constructed is contained in an air- and water-tight iron casing, with suitable cable and other connections and has been set up on the bottom of Lake Zuerich at a depth of from 10 to 15 feet. It is equipped for long-distance control. According to the *Engineer*, "The plant operated at full load continuously for 336 hours, that is, fourteen days and nights. A careful examination showed that it had not suffered the least injury. Many thousands of readings were taken during the tests, and the results show that the minimum guaranteed output has been largely exceeded. From time to time the ice formation on the evaporator tubes was checked by divers." The machine has a capacity of 30,000 calories at an evaporation temperature of —31° F.

An alloy has been produced by a Swedish engineer that is said to be as light as aluminum and as hard as steel and, therefore, highly suitable for the construction of flying machines. Reports have it that the new metal can be rolled or drawn to any desired extent, and that it is not affected by corrosive fluids. An allowance has been granted the inventor by the Board of Trade that will enable him to carry on additional experiments for the purpose of still further adding to the value of the alloy by rendering it proof against the action of sea water. Its strength is given as between 65 and 90 pounds per square millimeter.

Erie Railroad Modernizes System

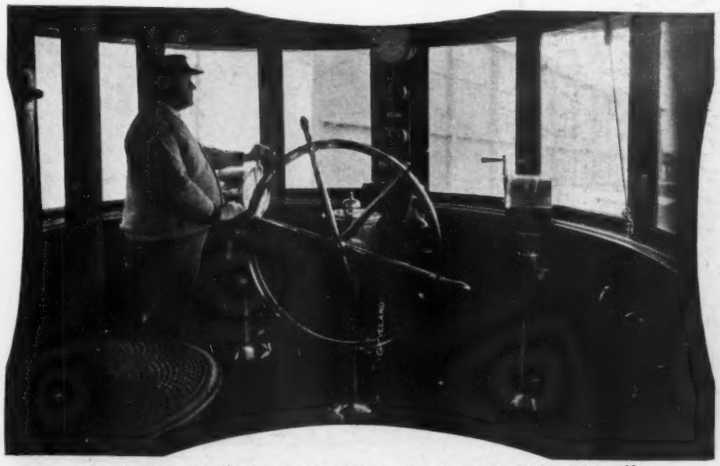


Lower Manhattan and a section of the East River waterfront as viewed from Brooklyn.

By C. H. VIVIAN

IT is estimated that $2,000,000,000 worth of freight is in transit on the railroads of the United States all the time. This amount constitutes idle capital, and any speeding up of railroad service obviously releases it and puts it to work just that much quicker. When a merchant can rely upon quick, safe delivery of freight, he can carry smaller stocks and buy more often. It is thus plainly apparent that efficient freight-handling has a direct bearing upon the prosperity of the country as a whole.

The railroads of the United States are the most dependable in the world, and they are becoming more dependable all the while. For five years now, a large automobile factory has been able to run on a 1-day inventory. For seven years that plant has never been short of cars for outbound shipments. Such examples are not unusual. Neither are they confined to establishments served by a particular railroad. As one line improves its service, it forces competing carriers to better theirs. Railroads have nothing but service to sell, and the public is discriminating. It buys transportation where it can get the most for its dollar. Inevitably, then, a railroad must go forward or it will go backward. There is no standing still.



Capt. Harold Hasbrouck at the wheel of the "Cleveland".

In recent years, the Erie Railroad has made noteworthy strides in providing improved facilities for rendering better service. This upbuilding process has been so marked and so extensive that it is hardly an exaggeration to say that the Erie has been revivified. Not so long ago, this railroad was referred to as "two streaks of rust and a right of way." Today far different terms are required to describe it. The rehabilitation is still going on, and each succeeding year finds the Erie in a better position to handle freight and passengers with dispatch and reliability.

The Erie Railroad was incorporated November 14, 1895, to take over the properties of the New York, Lake Erie & Western Railroad Company that were sold under foreclosure proceedings. Under the reorganization effected at that time, the company acquired a number of subsidiary roads. Since then, a dozen or more lines have been consolidated and merged into the system. The Erie also controls through stock ownership several small roads which are operated independently.

The Erie is one of the important so-called trunk lines extending from Chicago to the Atlantic seaboard. The section it traverses is the most productive industrial area in the United States, and it contains approximately 35 per cent of the nation's population. From a traffic standpoint, leading cities served directly by the Erie include New York, Chicago, Cleveland, Buffalo, Youngstown, Akron, and Dayton. It also serves Pittsburgh, Cincinnati, and Indianapolis through trackage arrangements with other lines.

The rejuvenation of the road dates from 1926, when the Van Sweringen Brothers acquired a controlling interest. Under the proposed consolidation of railroads to be submitted for consideration by the Interstate Commerce Commission, the Erie is to be assigned to the Van Sweringen owned Chesapeake & Ohio-Nickel Plate system. On January 1, 1927, J. J. Bernet, who had been with the Nickel Plate,

Two of the Erie's four new Diesel-electric tugboats that are speeding up the handling of freight in New York Harbor.

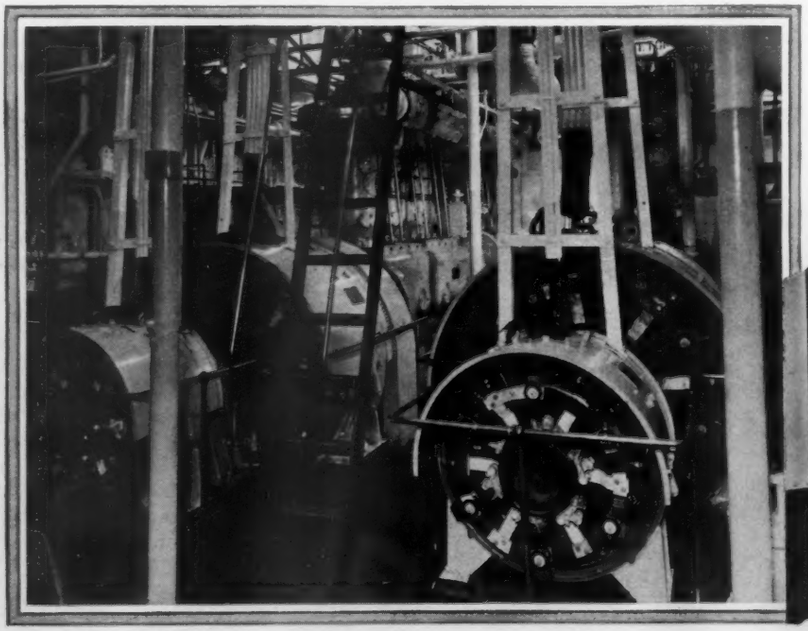
became president of the Erie. He immediately set in motion a program of housecleaning and rebuilding that has placed the road in the best all-around condition in its history. Mr. Bernet became president of the Chesapeake & Ohio during 1929, but the work he started has been continued along the same lines by his successor, Charles E. Denney, who had been vice-president of the Erie in charge of operation and maintenance.

The index to a railroad's efficiency is found in the figure known as operating ratio. Simply stated, this is the number of cents expended for operating expenses out of each dollar of revenue. The operating ratio of the Erie has had a marked drop under the new management. In 1928, alone, it was reduced from 81.86 to 76.30 cents. That year, operating expenses were cut by $5,000,000 and operating revenue was increased by $2,000,000, despite the fact that many railroads showed decreases.

During the past four years, approximately $110,000,000 has been expended in rebuilding and reëquipping the Erie as a modern, fast rail-transportation agency. Heavier rails have been laid, much progress has been made in rock-ballasting the line, and old, untreated ties have been replaced by creosoted ties that will last 50 per cent longer. Labor-saving machinery has been adopted for performing these operations. Pneumatic tie-tamping equipment is extensively employed, producing a better, more level, and more uniform roadbed. Each year the road distributes a large sum in prizes to supervisors and section foremen whose subdivisions or sections have shown the most improvement over the previous year. As a basis for making the awards, an inspection car accurately records such data as low rail joints, track gage, irregularities of surface, etc.

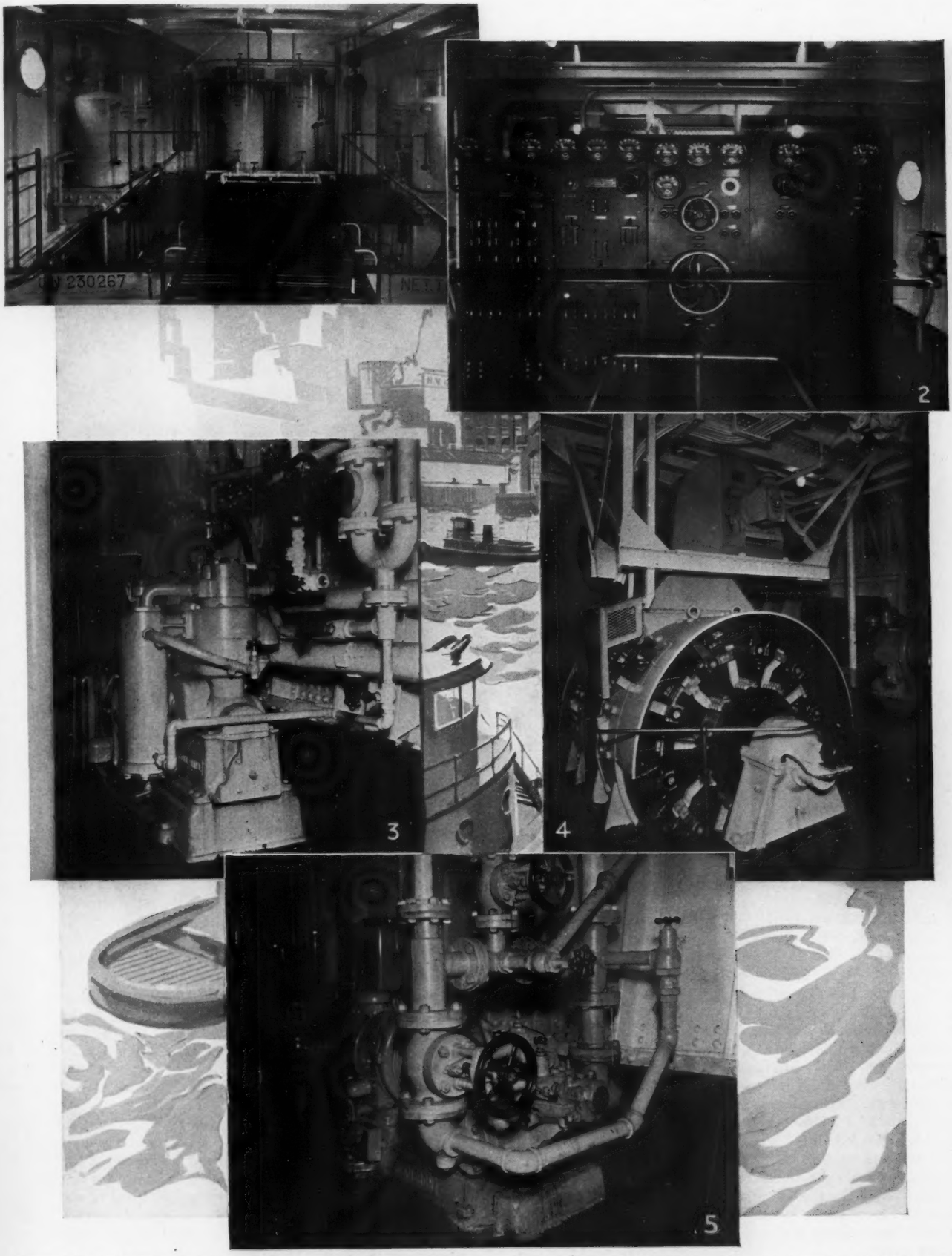
Several hundred obsolete freight locomotives have been withdrawn from service and supplanted by larger units of the most modern and powerful type. Each of these will haul 125 loaded freight cars. Many of the old locomotives remaining in service have been equipped with feed-water heaters, automatic stokers, etc. These steps have increased the number of tons carried per mile per train and have eliminated the need for helper engines on hilly sections. Equally important, the retirement of old locomotives has cut repair costs on motive power to a material extent. Similar economies have been effected by withdrawing thousands of old freight cars and putting on new, modern ones.

To enable the line to carry the heavier and longer trains, bridges have been strengthened and more and longer sidings installed. In line with the general policy of rehabilitation, new shops have been provided and existing



Left—These two oil-engine generator sets are the most powerful so far installed in any tugboat in New York Harbor.

Right—The motor-driven mechanism that steers the Diesel-electric tugboat.



Aboard the Erie tugboat "Cleveland".* 1—Grating above engine room, showing service fuel-oil tanks, lubricating-oil tanks, and traveling hoists for working upon engines. 2—The electrical switchboard. 3—Type 20 high-pressure compressor which supplies starting air for the main engines. 4—The 800-hp. propulsion motor, which is air cooled by the blower mounted above it. 5—Cameron motor-driven centrifugal pump which provides water for fire-fighting equipment.

ones improved. The right of way has been cleaned up, unnecessary structures have been removed, and essential ones have been repaired and repainted.

The Erie has been known primarily as a freight railroad, and 90 per cent of its transportation revenues has come from carrying freight. The new management has, however, decreed that the Erie is a railroad in the full sense of the word and that it will give the public all the kinds of transportation it needs and desires. Improvements are being made continually in the equipment and service of passenger trains. Notable in this connection was the inauguration of the Erie Limited between New York and Chicago in June, 1929. It provides all the luxuries and comforts possible in travel by rail. In common with all passenger service, the handling of commuters in the New York area has benefited by the provision of new steel cars and better motive equipment. Gasoline rail cars are now being introduced to some extent in this service.

The main line of the road is now double tracked. This fact, together with the improved equipment now available, enables the Erie to handle freight with dispatch. Its ability to transport perishables expeditiously is well known to shippers. Half a century ago the road carried the first California fresh fruits sold at auction in New York. Today it handles 95 per cent of all Pacific Coast citrus fruits destined for the New York market, the greatest in the world.

Due attention has been given to improving and expanding terminal facilities, and much has been done along this line in Jersey City, which serves New York—the most important point on the system. The location of the freight yards at the entrance to the Holland Tunnel is of decided advantage to the road. Trucks can be loaded directly from cars at a point only fifteen minutes removed from the principal market centers of New York. The present terminal is in reality closer to the destinations of most of the products shipped than it would be if located in Central Park on Manhattan Island.

The Marine Department in New York has been greatly augmented and improved during recent years, and every facility is now available for effectively handling freight and passengers. Piers for the loading and unloading of freight are situated at strategic points around the 170-square-mile area of the harbor. On the New Jersey side of the Hudson River, there is a pier and coaling station at Edgewater; seven piers are located at Weehawken and a new one is now under construction there; and two piers are in service at Jersey City where a third has been started. On the New York side of the Hudson, piers are available at 28th Street and at Duane Street. Those at the latter point—two in number—are devoted largely to the handling of fruit and produce. East River piers are located at South Street, near Coenties Slip, and at 149th Street. One Erie pier is in Brooklyn, as well as a number of contract terminals.

The brakeman sees to his lanterns.

A fleet of 295 craft is employed in the transfer of passengers and freight within the busy harbor. As of January 1, 1931, this fleet was made up of the following units: 7 ferryboats, 96 lighters, 16 tugboats, 34 car floats, 8 scows, 133 barges, and one floating steam pump.

In keeping with its program of securing the most modern and efficient equipment when making additions or replacements, the Erie has just placed in service in New York Harbor four Diesel-electric tugboats which bear the distinction of being the most powerful units of their kind in the metropolitan area. These boats—the *Cleveland*, the *Olean*, the *Rochester*, and the *Scranton*—will be used in moving car floats, barges, and other freight-carrying craft between the Weehawken and the Jersey City rail terminals and the manifold points of discharge and collection along the harbor waterfront.

The new boats are of all-steel construction to withstand the battering to which they are frequently subjected during their twenty hours of service every working day. Each is 108 feet long, 26 feet wide, and 13 feet deep, and has a displacement of 235 tons. They were designed by J. W. Millard & Brother, of New York, and built by the Pusey & Jones Corporation at Wilmington, Del. The *Cleveland* was placed in service last October, and the three others were put in commission as rapidly as they were completed, the last one reaching New York on December 30.

Diesel-electric tugboats are not strangers to New York Harbor, or to other ports of the world. Each succeeding year brings increased recognition of their economy and desirability and sees more of them in service. Briefly summarized, the outstanding features of such a craft are: low operating costs, flexibility of power, ease of handling, constant readiness for service, and freedom from ashes or smoke. Since no fireman is required there is a saving of one man in the crew. As compared to a steam-operated tug, there is greater availability of service. It is unnecessary to get up steam before starting; and the tug is always ready to go with little more preliminary effort than it takes to start an automobile. Time and labor are saved in getting fuel aboard.

The full power of the propulsion motors is available at the propeller shaft at all times because the engines develop a constant horsepower. Thus the maximum energy can be used even when the speed of the boat is reduced by the weight of its tow. Likewise the propeller speed can be reduced without varying the engine speed.

The Diesel-electric tug is controlled entirely from the pilot house, thereby increasing the maneuverability and decreasing the likeli-

A group of views showing how the Erie Railroad cares for freight and passengers. 1—Cantaloupes on display at the Duane Street pier in New York. 2—A corner in the New York fruit terminal. 3—Pier No. 9 at the Jersey City entrance to the Holland Tunnel. 4—Mealtime on an Erie dining car. 5—Loading a motor coach for shipment.

hood of accidents. Signaling to the engine room is eliminated. The pilot, with a clear view to all sides from his glass-enclosed station, steers the boat and applies the power at his will. In front of him are meters that inform him of the electrical performance at all times.

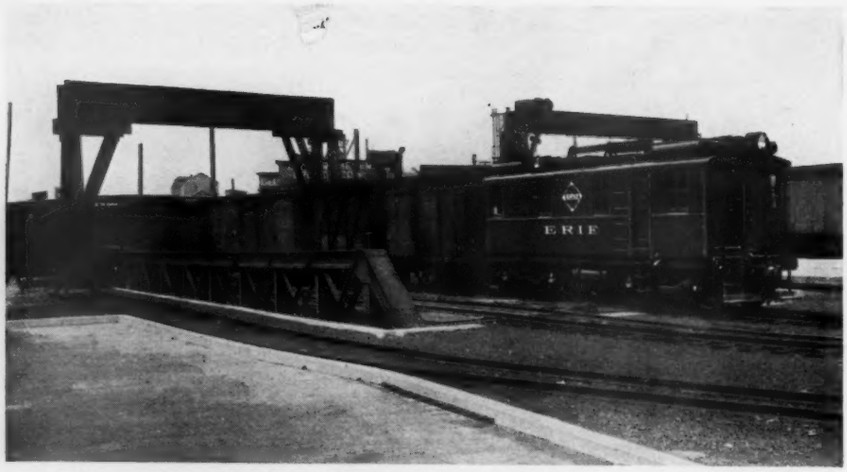
Each of the four new Erie boats is powered by two Ingersoll-Rand Type PR, 6-cylinder, 4-cycle, solid-injection, 15x20-inch oil engines. Each engine develops 500 hp., and is direct connected to a General Electric 330-kw., 250-volt generator and a 30-kw. exciter. These generating sets operate at 270 revolutions per minute. The current is supplied to a General Electric shunt-wound propulsion motor which consists of two armatures mounted on a common shaft. Either or both engines can furnish power to either or both armatures. This motor is capable of delivering its full 800 hp. at any speed from 105 to 135 revolutions per minute.

The oil engines operate on solid injection of fuel oil, which is sprayed into the center of the combustion chamber through two opposing nozzles. This results in complete atomization and mixture with the air, which is drawn from the atmosphere into the combustion chamber during the previous revolution. The simplicity and accuracy of this combustion principle are shown by the unusually high economy and the freedom from smoke.

Air at 250 pounds pressure for starting the engines is supplied by an Ingersoll-Rand Type 20, two-stage compressor which is driven by a 10-hp. motor. A 4-kw. generator, driven by a Hill Diesel engine, provides power and light for stand-by service.

Fire-fighting equipment consists of a Cameron 3-stage centrifugal pump with a capacity of 500 gallons per minute against 150 pounds discharge pressure. It is driven by a 75-hp. motor. It supplies water to a monitor nozzle on top of the pilot house and to outlets at both sides of the deck house forward. A Cameron No. 3 NFV centrifugal pump, with a capacity of 250 gallons per minute, furnishes cooling water for the main engines. A "Monco" boiler, fired by a Ray oil-burning system, provides heat for the pilot house, engine room, and crew's quarters. Storage capacity is available for 10,000 gallons of fuel oil in two tanks. This is sufficient to operate a boat for ten days at full horsepower, or for about three weeks under normal operating conditions. The tanks can be refilled quickly and easily.

In appearance these Diesel-electric boats differ little from steam-driven tugs. Although not required as an operating feature, a stack is retained and serves to house the exhaust pipes of the engines and to ventilate the engine room.



The Erie uses four of this type of oil-electric locomotive for handling freight in the New York area.

RADIUM AWAITING TEST STORED IN BIG LEAD-LINED SAFE

FOR the safety of the laboratory workers at the United States Bureau of Standards, Washington, D. C., there has been installed in the basement of the East Building a safe of a special kind for the storage of radium preparations, of which increasingly large quantities are being sent to the Bureau for testing.

Most of the radium now used in this country comes from Africa; and while the importers generally accept foreign certificates on that radio-active element, the ultimate purchasers do not, as a rule, utilize it in the study and the treatment of malignant diseases until after it has passed through the hands of the laboratory experts. During the fiscal year ending June, 1930, approximately 10 grams of radium, valued at $650,000, were tested by them. This amount, it is estimated, will be exceeded in 1931, because there is now concentrated at the Bureau what is said to be one of the largest single lots of radium ever received there. It consists of 50 tubes each containing 100 milligrams of radium sulphate worth all told $325,000.

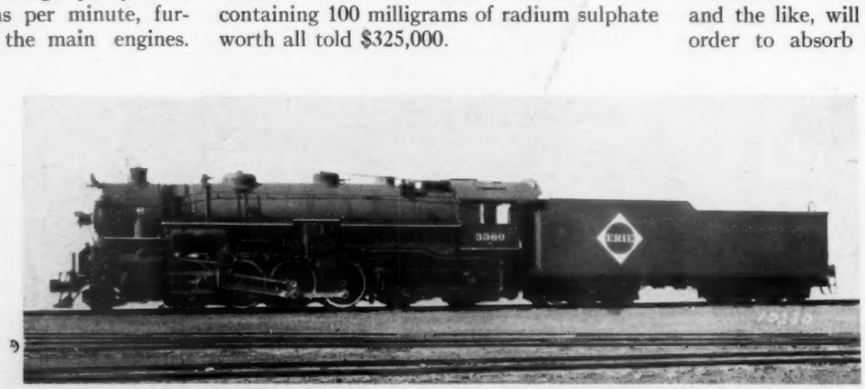
The increasing demand made upon the laboratory facilities has led to the building of the safe, in which all but the radium undergoing test on any particular day is now stored. This is necessary to adequately protect the personnel against the tissue-destroying emanations and to prevent the setting up of disturbances that might interfere with other near-by work. The safe weighs 9½ tons and is lined throughout with insulating lead 6 inches thick.

WINDOWLESS INDUSTRIAL PLANT

NOW and again of late the statement has been made that the industrial building of the future would be windowless—without even a skylight to admit natural light. While the idea does not, on the face of it, appeal to us at all, yet its advocates claim that such a factory, if built along the most approved lines as regards heating, lighting, ventilation, etc., would be not only a most desirable place to work in but would increase efficiency as well.

The scheme is to be tried, according to *Stone*, by The Simonds Saw & Steel Company of Fitchburg, Mass., which has had plans drawn up for a solid-wall, stone structure that is to cover two city blocks. Certain interesting details regarding it have been announced, and these are as follows: The inside walls and ceilings are to be painted blue, green, and white, while the machinery is to have an orange coat to heighten visibility and to cut the accident rate. Hundreds of 1,000-watt lamps, capable of giving off beneficent ultra-violet rays, are to be installed so as to provide uniform light intensity throughout. By means of the ventilating system the air will be changed every ten minutes—the fresh air entering the building being purified and brought to the proper temperature before circulation. Heavy machines, drop hammers and the like, will rest on cork mattresses in order to absorb vibration and to combat noise; and to further deaden sound, there will be walls and ceilings with special acoustic properties.

The effects of environment, atmosphere, light, temperature, sound, and color on workers have all been taken into consideration in designing this "blind" plant which is being built at a cost of $1,500,000.



One of the new freight locomotives on the Erie Railroad.

Canal section through rock cut where "gunite" was used to consolidate fissured and broken rock.

Arid Lands Made Fruitful by Work of Bureau of Reclamation

By P. M. SHERIGER

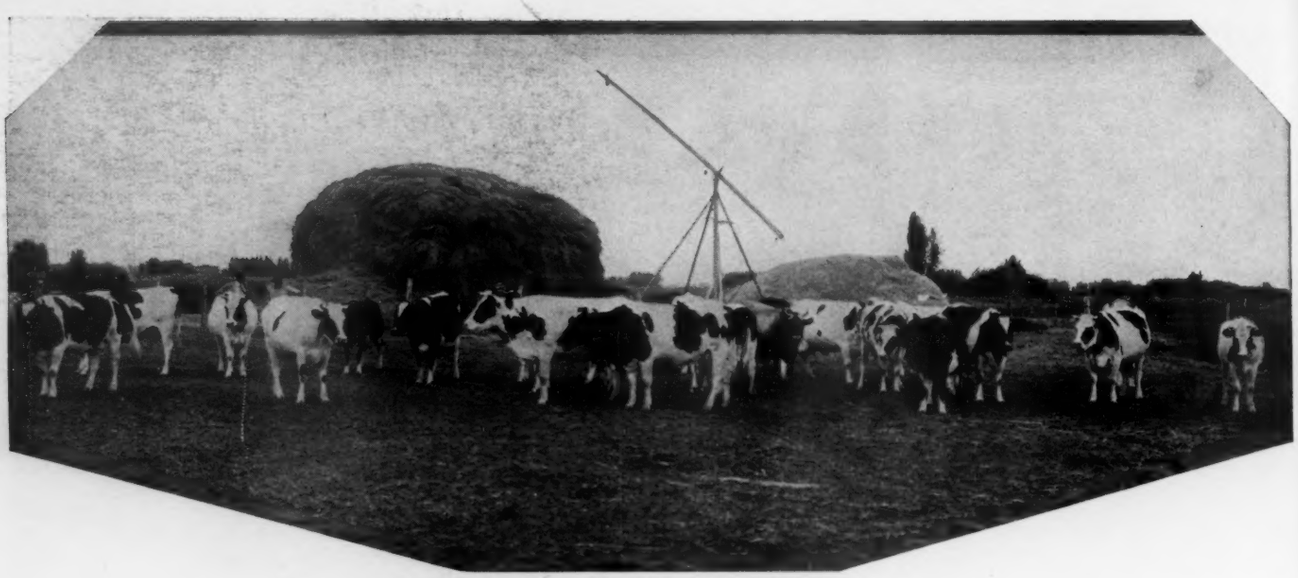
WHAT was an uninhabited desert dotted only with sage brush back in 1904 is now a farming region producing annually crops and other foodstuffs having a gross value ranging from $3,500,000 to $4,500,000. Such is the wonder-working virtue of water applied to a soil that is inherently fertile—the soil in this case being in the south-central section of Idaho and known as the Minidoka Project.

The Minidoka Project is the outcome of work well done by the Bureau of Reclamation of the United States Department of the Interior. The project covers about 200 square miles, and its southern edge lies close to a range of mountains that rises to an altitude of 10,000 feet and bears ample evidence of the volcanic disturbances that occurred there at various periods in the remote past. The soils on the project range from sandy to light clay; and the clays and loams, which predominate, are locally known as "lava ash"—the latter representing the disintegrated outpourings of volcanoes which were active thousands of years ago.

People that have never visited Idaho are familiar with the state through those very fine potatoes that become doubly tempting when baked; and the farms of Idaho produce other things that also are in wide demand. Nature has been kindly to the state, and the Minidoka Project reflects this in numerous ways. The climate is dry and invigorating, and the sun shines radiantly upon the land a large part of every year. There is an average annual total of 263 clear days; and as a rule the frost-free period covers 132 days. Temperatures usually range from 110° F. in summer to 10° below zero in winter. The average elevation of the irrigable area of the Minidoka Project is 4,225 feet above the level of the sea; and nearly all the 120,000 acres of the land in question are under cultivation.

Excavating canal in earth section with a large dragline.

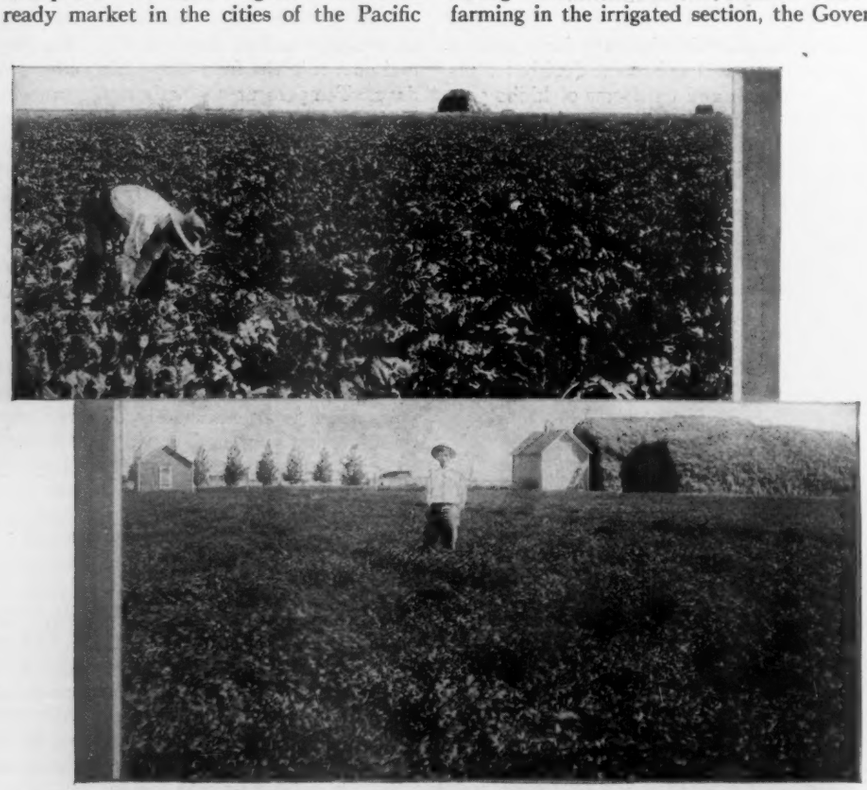
Water for irrigating the land is obtained from the natural flow of the Snake River, which is supplemented by the water stored in Lake Walcott, near Minidoka, Idaho, in Jackson Lake near the Yellowstone Park in Wyoming, and in the American Falls Reservoir, which is approximately 60 miles above the diversion points. The water is delivered through canal and lateral systems to each farm unit; and the water rights possessed by the Minidoka Project in the three reservoirs just mentioned are sufficient to furnish water to cover the land evenly to a depth of about 48 inches. The meaning of this can be better understood when the reader is reminded that the average annual precipitation, recorded over a term of more than twenty years, is 11.5 inches, and occurs mainly in the winter and the spring.



Herd of registered Holstein cows on a dairy farm.

The greater part of the area now cultivated is devoted to the growing of alfalfa, grains, potatoes, and sugar beets. The yield of alfalfa, when proper methods of farming are employed, runs from 4 to 5 tons per acre. Wheat crops of from 50 to 60 bushels per acre are not unusual; and from 150 to 350 bushels of potatoes per acre are obtainable, depending upon the skill of the farmer. The average yield of sugar beets is about 11 tons per acre, but in numerous instances crops of more than 20 tons have been realized. The Minidoka Project is an excellent country for livestock; and climatic conditions are very favorable to the raising of turkeys. A considerable share of the produce of these irrigated acres finds a ready market in the cities of the Pacific Coast. The project is served by the Union Pacific Railroad; and the entire area is within easy reach of loading stations.

At Minidoka Dam the Bureau of Reclamation reared a power house generating 13,500 hp. of electrical energy; and this is distributed at low cost to 1,200 farmers and to the towns on the project. The current is also utilized to drive pumps by which the water, in three lifts, is raised sufficiently to irrigate elevated lands. The pumping lifts are, respectively, 30, 60, and 90 feet. The Snake River cuts the Minidoka Project into two parts, and the cultivated area described constitutes only one of the two main divisions of the undertaking. Because of the successful results of farming in the irrigated section, the Government decided to extend the work of the Bureau by providing water also for what is now known as the Gooding Division of the project. This development was authorized by President Coolidge on July 7, 1928; and steps are now being taken to put stored water from the Snake River on 85,000 acres of land previously inadequately supplied.



Top—Fine crop of sugar beets. Bottom—Alfalfa thrives on the irrigated lands.

To be specific, the Gooding Division embraces approximately 40,000 acres of land without water right lying north of the Twin Falls North Side project and 45,000 acres of land in the vicinity of Shoshone and Gooding that have only a partial water supply from Wood River. Water for this division will be drawn from the American Falls Reservoir and will be diverted at Milner Dam into a 70-mile main canal. Perhaps it might be interesting to some of our readers to learn about American Falls Dam. This dam is located on the Snake River near the City of American Falls, Idaho, and was built to provide additional storage for irrigation in the Snake River Valley. It is a concrete gravity structure, with rolled earth-fill embankments at the ends, and has a total length of about a mile and a maximum height of 87 feet. The reservoir created by the dam is 25 miles long and 12 miles wide, with an area of 56,200 acres and a capacity of 1,700,000 acre-feet. The stored water is used to augment the supply of numerous existing canals that serve a total of approximately 600,000 acres situated both above and below the reservoir. The American Falls storage will supply about 170,000 acres of irrigable land in the Minidoka Project; and the completion of the Gooding Division will create a market for 400,000 acre-feet of water as yet unsold but available in American Falls Reservoir. The dam was begun in February, 1925, and completed in September, 1927, at a cost of $3,060,000.

Work was actively started on the Milner-Gooding Canal of the Gooding Division in the summer of 1928, and has been underway ever since. The main canal is being excavated so as to divert water from the Snake River at Milner Dam, 25 miles east from Twin Falls.

Flock of Hampshire sheep in prime condition.

Idaho; and it is being run in a northwesterly direction for a distance of 70 miles, where it will intersect a canal now serving lands in the neighborhood of Gooding. The latter canal is part of a system built a little more than 22 years ago to provide irrigation, by gravity, to some 80,000 acres of land—water being drawn from the Big Wood and the Little Wood rivers. The canal now under construction will permit the water from these rivers, at present being used below their levels, to be devoted exclusively to irrigating 36,000 acres of higher lands and will thus render possible their profitable cultivation.

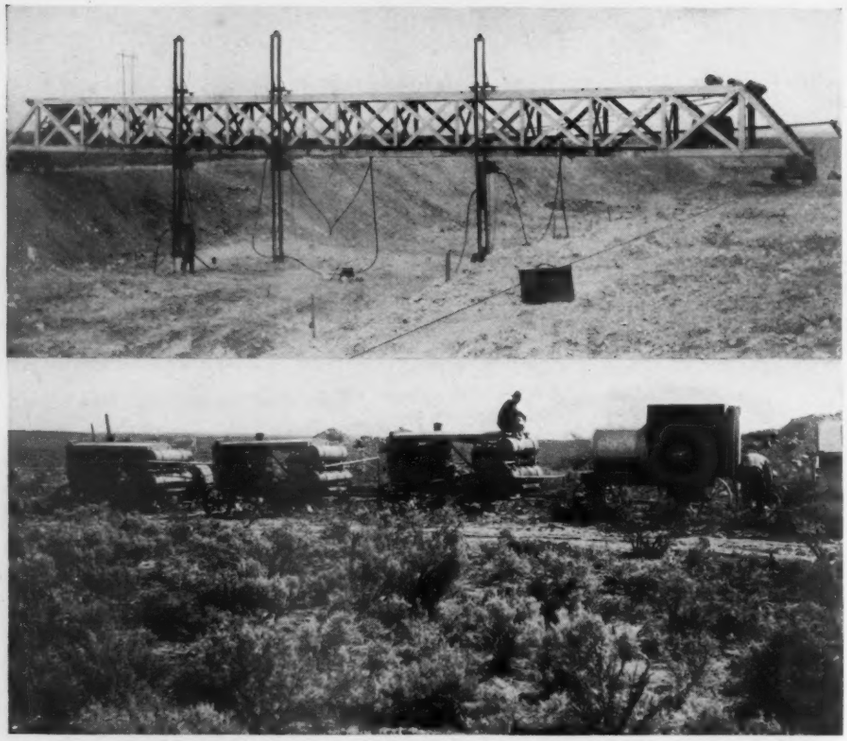
The Milner-Gooding Canal is to have a capacity of 2,750 second-feet for the first 3½ miles; and of this flow 1,000 second-feet will be delivered to the canal of a commercial company which, under existing conditions, is not of sufficient capacity to provide adjacent territory with the water needed. This section of the main canal calls for a deep cut in rock. A considerable part of the following 64 miles of canal is also in rocky country; and the capacities of the connecting sections will range from 1,600 second-feet down to 450 second-feet. The final three miles of this man-made waterway is to traverse a basaltic region, devoid of soil, where a concrete flume 11 feet wide and 7 feet high will be constructed.

The canal has an average drop of 1 foot to the mile. The banks slope ¼ to 1 in rock, with a bottom width of 25 to 34 feet, as circumstances require. In earth, the banks slope 1¼ to 1, while the bottom width varies from 40 to 50 feet. The first 1½ miles of the canal has been carried in the main through lava, and cuts about 40 feet have been made. The base of this section has been surfaced with concrete having an average thickness of 6 inches; and any uncovered fissures have been filled and all fractured rock masses consolidated with "gunite". Mechanical equipment of different kinds have been employed by the contractors to promote rapid progress; and the work has gone forward so well that 1,051,000 cubic yards of rock had been excavated up to December 1 of last year. The total quantity of rock excavation needed to complete the 70-mile canal will be approximately 1,382,000 cubic yards. The excavating of rock was begun in December, 1928; and from June to the middle of last December, it was being removed at the rate of about 107,000 cubic yards per month. This is an excellent indication of the effectiveness of the rock drills on the job.

Winston Brothers Company, of Minneapolis, Minn., was the first contractor to work on the canal. The section awarded that company is about 10,000 feet in length and, for the most part, called for earth excavation—that is, 16,000 cubic yards of solid rock and 647,000 cubic yards of earth. The shallowest part of that section is 14 feet in depth while the deepest is 36 feet. The contractor disposed of most of the earth with a dragline machine equipped with a 3-yard bucket; and in the course of an 8-hour shift was able to move from 750 to 1,000 yards of material.

The Derbon Construction Company, of Seattle, Wash., secured the intake section that entailed the disposal of something like 218,000 cubic yards of rock and 145,000 cubic yards of earth. Part of the compressed air required for this work was furnished by a number of Type 20 portables, each capable of delivering 220 cubic feet of air per minute. In doing the rock excavating, the contractor

Top—Harvesting wheat on irrigated land. Bottom—Farms produce from 150 to 350 bushels of potatoes per acre.



Top—Three X-71 rock drills mounted on a mobile 82-foot wooden truss. Bottom—Battery of three Type 20 portable compressors furnishing air to the rock drills on this bridge.

utilized types R-12, R-39, and X-59 "Jackhamers", together with several S-70 drifters. At the start, the plan was to mount the S-70's on tripods; but this was abandoned, and 2-man handles were fitted to the S-70's so that they could be used as sinkers. This adaptation was necessary owing to the rough nature of the rock surface.

The third contractor, John Phillips Company, of San Francisco, Calif., obtained the job of removing 102,000 cubic yards of solid rock and 1,045,000 cubic yards of earth. Compressed air to operate R-12 "Jackhamers" was furnished by a battery of 10x8-inch Type 20 portables. Air for the blacksmith shop—provided with a No. 34 Ingersoll-Rand sharpener and a No. 6-F oil furnace—was obtained from a 5½x5-inch Type 20 portable.

Mittry Brothers Construction Company, of Los Angeles, Calif., has been at work on two separate sections containing 731,000 cubic yards of solid rock and 2,076,000 cubic yards of earth. The drilling equipment has been made up, for the most part, of three X-71 drifters mounted on a Type Thirty caterpillar tractor, of three X-71's mounted on a wooden bridge spanning the dirt banks of the canal, and of several S-49 "Jackhamers". The air supplied has been drawn from two sources—from a 17 & 10x14-inch electrically driven XB-2 compressor, mounted on skids and shifted from time to time by a caterpillar tractor, and from a numerous battery of Type 20 portables. A No. 50 sharpener and a No. 25 oil furnace in the blacksmith shop have been used to recondition the drill steels.

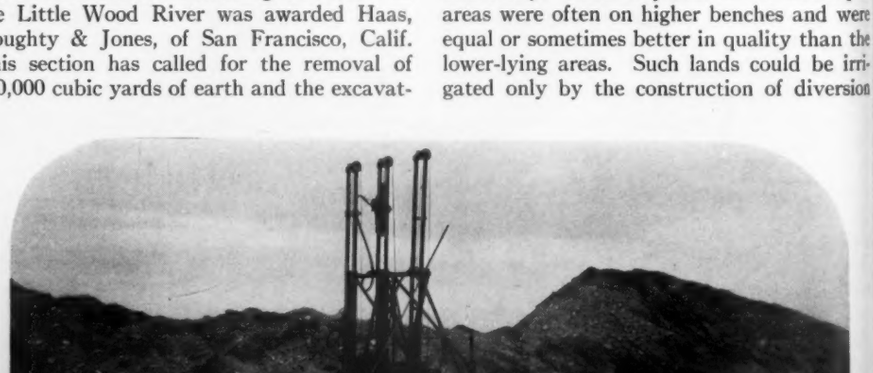
The development of the bridge and the caterpillar rig was influenced by a Model A wagon drill. Work was started with two wagon drills, and good footage resulted—each machine accomplishing about 500 linear feet per 8-hour shift. However, because of the very rough surfaces of the rock, considerable difficulty was experienced at times by the operators in moving these units, and by way of a solution of the problem two derricks and drills were mounted on a caterpillar tractor. Performances being so encouraging, a third drill was added a little later. Now the bridge is built for such sections where uniform banks are formed by stripping operations. As a rule, the holes drilled by the tractor and the bridge rigs have been of such diameter that springing to obtain ample powder capacity has been unnecessary.

The final section extending the canal to the Little Wood River was awarded Haas, Doughty & Jones, of San Francisco, Calif. This section has called for the removal of 770,000 cubic yards of earth and the excavating of 250,000 cubic yards of solid rock. In addition to other equipment, the contractor has made use of several 10x8-inch Type 20 portable compressors to furnish air for the S-49 and the R-39 "Jackhamers" employed in drilling the excavated rock.

Morrison-Knudsen Company, of Boise, Idaho, has recently started work on that stretch of the canal that will run from the Little Wood River to the Big Wood River. In the country beyond the Little Wood River the canal will have to be cut through a bare lava formation for a distance of 3½ miles. This will, of course, necessitate the extensive employment of rock drills. The farmers who will eventually benefit by this undertaking, which will call in its entirety for an expenditure of more than $4,000,000, will scarcely realize how much hard work had to be done in order to provide their fertile acres with indispensable water.

At the close of 1930 most of the work on the canal from Milner Dam to the Little Wood River was finished, and operations are going forward satisfactorily on the section between the Little Wood River and the Big Wood River. The remaining stretch, that between the Big Wood River and the North Gooding Canal, will shortly be let to contractors; and the completion of this part of the undertaking will round out the project so far as the main canal is concerned. A considerable sum will have to be spent subsequently in providing laterals leading into such adjacent public land as will lend itself to irrigation by water fed by gravity from the canal.

Some one may ask why is it desirable for the National Government to engage in irrigation projects? This question has been thus answered by the Bureau of Reclamation: "The early pioneer could, with a team and plough in the course of a few days' work, divert the water from small streams to bottom lands and produce good crops by irrigation. Within a short period of time these streams were fringed with farms and the development of water for irrigation became more difficult and costly. Lands adjacent to the developed areas were often on higher benches and were equal or sometimes better in quality than the lower-lying areas. Such lands could be irrigated only by the construction of diversion



Caterpillar tractor equipped with three derricks and three X-71 drifters. The rock drills are raised by air hoists.

An extensive shot in a rock-drilled section.

dams, storage works, and large canal systems. Such works, constructed by the United States Government, together with the lands served with water, all located in a more or less compact area, are known as Federal irrigation projects."

By the end of 1929, the Bureau of Reclamation had built 52 storage dams and had three others under construction, with a combined volume of 23,822,710 cubic yards, and it had reared 49 diversion dams and had two more underway, representing a total of 1,189,500 cubic yards. The storage reservoirs have an aggregate capacity of 14,608,320 acre-feet of water—that is, 4,763,394,000,000 gallons! In addition to these, thirteen storage and nine diversion dams have been built by the Bureau on Indian irrigation projects. The complete canal system includes 16,557 miles of canals, ditches, and drains, 148,462 canal structures, 11,631 bridges, 14,043 culverts, 4,811 flumes, 1,203 miles of road, 3,350 miles of telephone line, and 2,056 miles of transmission line. The excavation of earth, rock, and hardened materials has amounted to 276,822,500 cubic yards—the equivalent of a single solid column 1,500 feet square and 3,321 feet high!

To quote again from data made public by the Bureau of Reclamation: "There are 28 projects, located in whole or in part in fifteen of the arid states. On June 30, 1929, twenty-seven years after the passage of the reclamation act, a volume of water had been impounded in reservoirs or diverted from regular stream channels sufficiently large to irrigate 1,922,330 acres of project land and to furnish supplemental irrigation under the Warren Act of February 2, 1911, to 1,480,040 acres of land having an insufficient water supply for full crop production."

The average acre value of crops produced on these irrigated lands during 1929 was $60, or a total crop value from the lands benefited by Federal project works aggregating $161,179,880. This crop value represented approximately 80 per cent of the total construction cost of all reclamation projects up to that date. During the existence of the Bureau of Reclamation, more than $1,642,000,000 worth of crops has been produced on Bureau projects. Furthermore, the value of livestock in 1929 on the 24 operating projects directly under the supervision of the Bureau was $26,420,689, and that of farming equipment amounted to $16,246,570, or a total stock-and-equipment value of $42,667,259.

Serving the projects and adjacent areas, so it is reported, are seventeen beet-sugar factories which, in 1928, produced more than 500,000,000 pounds of sugar and paid $12,800,000 for beets and about $5,500,000 to water users on Federal projects. During 1928, shipments to seventeen of the 24 operating projects numbered quite 95,496 carloads, valued at $119,619,000; and shipments from stations on these projects totaled 112,608 carloads, having a combined value of $158,295,000. The foregoing facts and figures, astonishing as they are, answer the question not infrequently asked: "Do the irrigation projects fostered by the Government justify the money spent on them?"

Mr. E. B. Darlington is the engineering superintendent, on behalf of the Bureau of Reclamation, on the Minidoka Project, and Messrs. John K. Rohrer and Clyde H. Spencer are associate engineers. The designs for the work were prepared in the Denver office of the Bureau of Reclamation by H. R. McBirney, engineer for canals, under the supervision of the chief designing engineer, J. L. Savage. All engineering and construction operations are under R. F. Walter, chief engineer, also with headquarters in Denver.

HINT ON CLEANING FIELD COILS AND ARMATURE WINDINGS

"COMPRESSED air", writes an electrical engineer, "is the most satisfactory medium for cleaning field coils and armature windings. The air must be dry and the pressure not high enough to injure the insulation. Rotate the armature slowly if possible; and after the oil, dust, and loose dirt have been blown off clean the windings with benzine. Care must be taken not to have an open flame near, because it may cause an explosion.

"I use a 3-gallon blowtorch tank containing 1½ gallons of benzine, and spray the coils and armature with 30-pound air. After this treatment, dry air is used to blow out all the loosened dirt and oil. This process is repeated until the windings are clean. After cleaning, the armature and field coils are given plenty of time to dry. When the insulation has been cleaned a coat of insulating varnish is applied. After this has had time to dry a second coat is applied. This treatment gives a satisfactory job."

A moving platform to facilitate loading and unloading is the special feature of a motor truck that has appeared in England. The floor of the vehicle consists of an endless rubber belt which runs over a succession of rollers. Each of the end rollers is fitted with driving gear and crank handles, one on either side. It is evident that such an arrangement would greatly simplify discharging a load; and, by reversing the movement of the belt, help in distributing a load. Bulk commodities, such as coal, can be unloaded, it is said, at the rate of two tons in ten seconds.

Big electric shovel used by Mittry Brothers Construction Company.

Home-Made and Nature-Made Ice

ACCORDING to information recently made public by one of the departments of the Government, plants engaged in the manufacture of ice in the United States had a total production of 43,609,208 tons during the year gone. That output at the factories was valued at $199,865,427—representing an increase of nearly 8.5 per cent over the production in the twelve months of 1927. These figures indicate in a general way the part played by manufactured ice in providing for the well-being, comfort, and pleasure of the people of this country; but the data do not tell the story of another phase of our dependence upon machine-made refrigeration.

Another report from the Bureau of the Census discloses that the total shipments or deliveries of mechanical refrigerators in 1929 by establishments in the United States engaged primarily in the manufacture of such refrigerators had a value, at the factories, of $147,009,587. That sum indicated an increase of 62.9 per cent in sales of mechanical refrigerators between 1927 and the close of 1929. Of these no fewer than 596,164 were domestic electric refrigerator units, complete with cabinets.

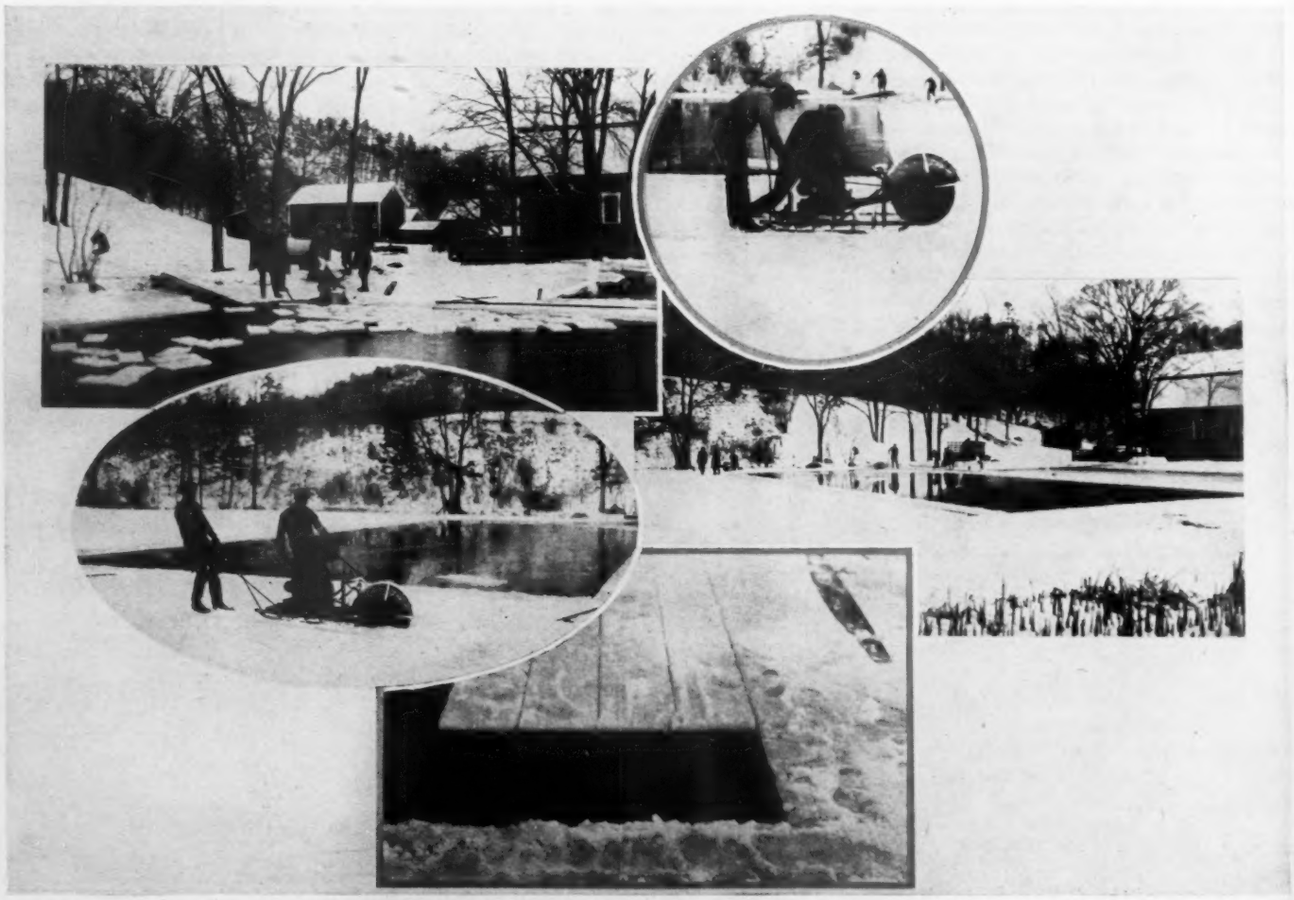
Astonishing as is the magnitude of the industry concerned with mechanical refrigeration, still very large quantities of ice continue to be harvested from ponds, lakes, and rivers. This is especially true in those parts of the nation where climatic conditions can commonly be counted upon to produce a crop of ice on conveniently located bodies of fresh water. Like every other line of endeavor, the harvesting of ice of nature's making has undergone a measure of modernizing—the object, of course, being to cut and thereafter to handle the ice with the least expenditure of man power. Various equipment have been devised to promote operating economies in this seasonal field of work.

In the past, much toilsome labor was associated with the sawing of slots in the ice so that it could be harvested in blocks of virtually uniform sizes—this being desirable as an aid in storing it in icehouses and afterwards in withdrawing it for immediate use or distribution and sale. Later on, means were evolved by which the ice could be scored by horse-drawn contrivances—the scoring, like the glazier's scratch on glass, making it relatively easy to fracture the ice to form with the blows of an ax or crowbar. Next arrived the day of power-driven saws.

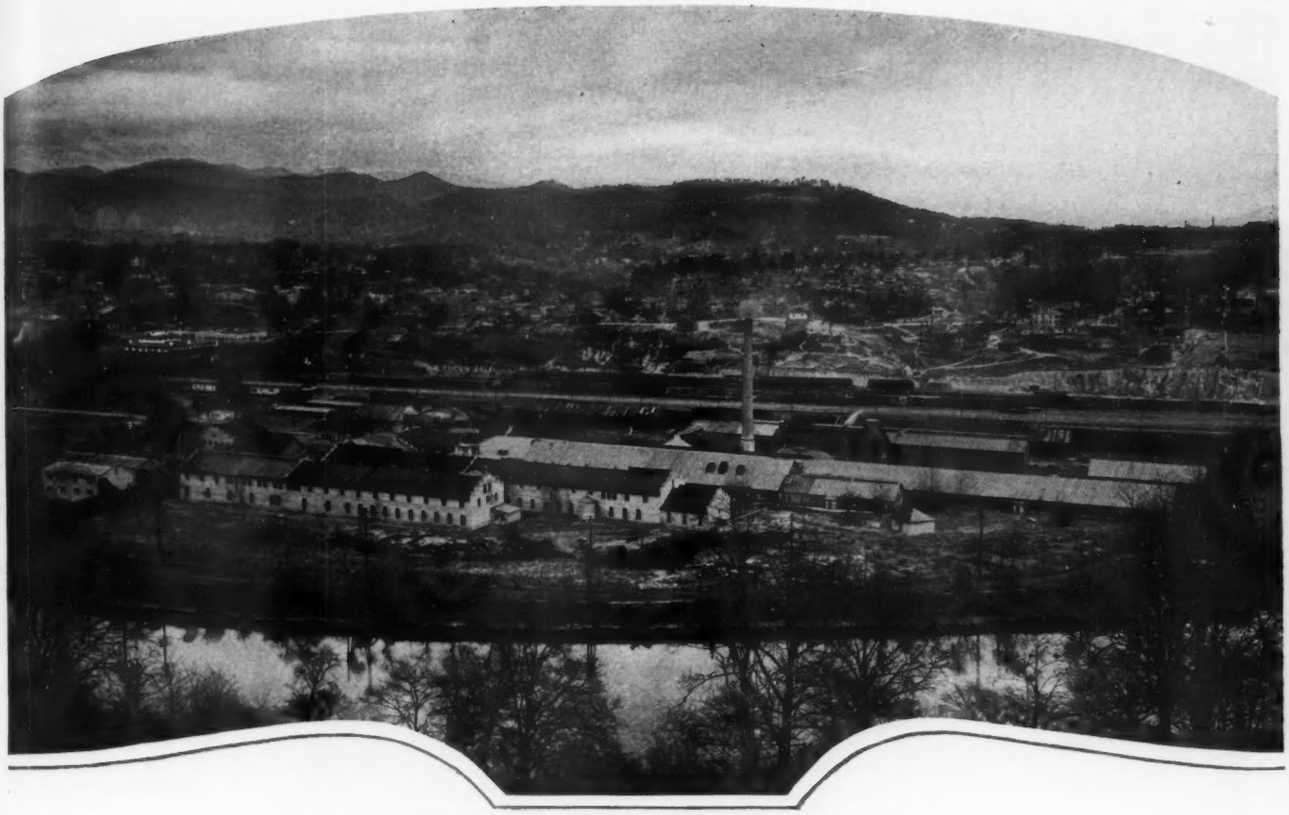
The accompanying pictures show how icehouses are filled in a section of Massachusetts at the present time. The ice is slotted with a gasoline-driven circular saw mounted on a pivoted arm that permits considerable vertical movement. All that the operator has to do is to guide the machine, and the whirling disk cuts into the ice so deeply that only a moderate blow is necessary to complete the fracture. The saw cuts longitudinally and crosswise slots so that cakes of uniform size can be readily obtained. The creeping action of the saw in motion aids the advance of the apparatus, which is mounted on twin runners much like those of the familiar sled.

An outfit of the nature just described is capable of slotting a wide expanse of ice in the course of a single working day, thus making it practicable and profitable to harvest a good many tons in that interval. By the use of motor trucks, the ice can be expeditiously transported from the source of supply to the storage places. In small and scattered communities, ice of nature's making will continue to hold its own for years to come against that produced mechanically.

Work on an ocean to ocean highway has been started by the Mexican Government. Upon completion this road will link Mazatlan, on the Pacific, with Matamoros, situated on the east coast and just below the line between the United States and Mexico.



Power-driven saw makes harvesting ice easy work in Massachusetts.



Tannery of Hans Rees' Sons, Inc., Asheville, N. C.

Tanning Leather for Special Services

Belts for Power Transmission Call for Leather Possessing High-Grade Characteristics

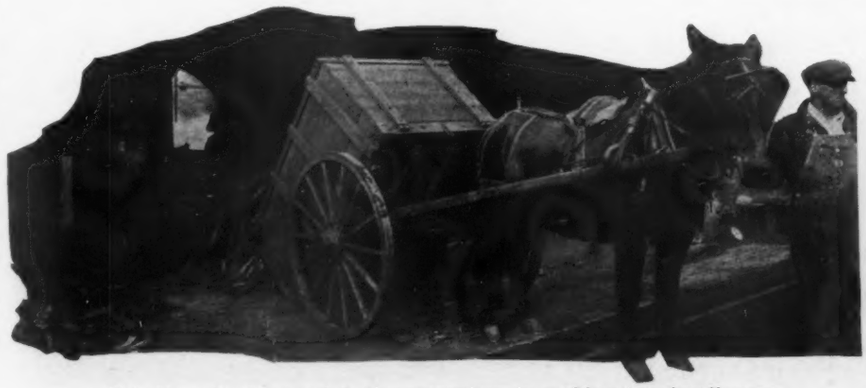
By A. S. TAYLOR

WHEN and where leather belts were first used for power transmission is not known—it was probably a long while ago. More than likely the pioneers in adapting leather to that purpose used it because nothing else was available at the moment. Experience, however, proved the wisdom of the choice. The modern engineer who frequently employs leather-belt drive does so with a full understanding of the advantages of leather in that service. He has numerous excellent reasons for his selection.

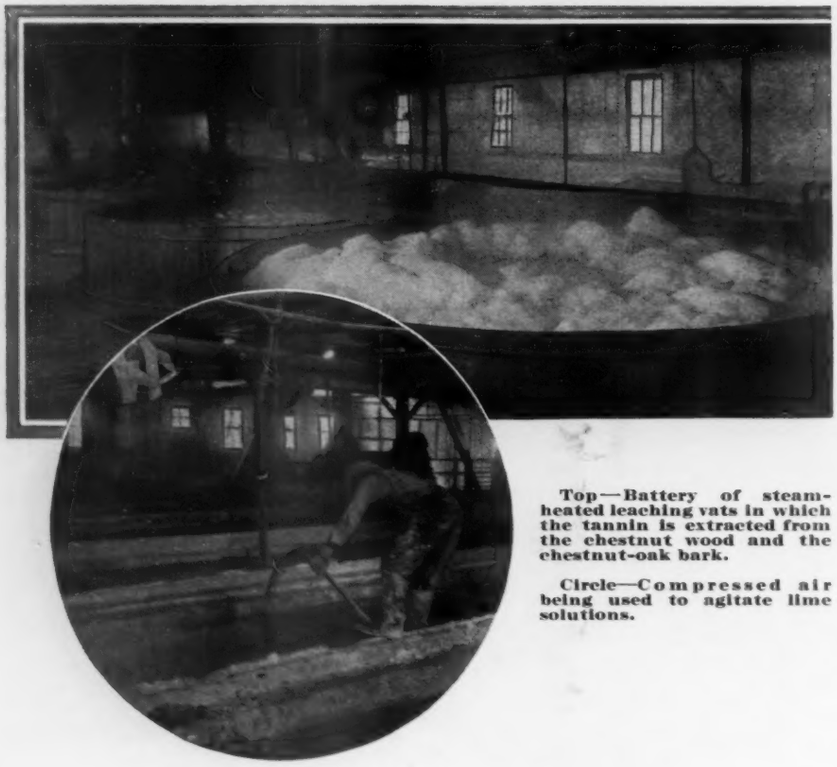
To be satisfactory, a leather belt should be able to exert sufficient adhesion when in contact with a whirling flywheel to transfer the power developed there to the spinning pulley over which it travels next. The belt should be so pliable that it will withstand repeated flexing when making its prescribed circuit, perhaps several hundred times a minute. The belt must measure up to exacting requirements as to strength, having the while a tendency to stretch but little; and in the majority of instances a leather belt is expected to function day in and day out for a period of years. Such, in short, are the characteristics called for in present-day, first-class leather belting.

Leather belts are now made in a wide range of widths and in varying lengths; and they reflect in their get-up the manner in which modern machinery differs from kindred equipment of years gone. Not only are the transmitted powers generally higher today than previously but the operating speeds are uniformly greater. To express it popularly, leather belts live a faster and more strenuous life than they did two or three decades back. Accordingly, the producers of such belting meet these newer conditions first by turning out leathers having superior qualities and then by fabricating these leathers into the belts now specified by the engineering fraternity. Much could be written on the subject of leather belts, but we are going to limit ourselves to a description of how leather for belting is made.

Before telling what is done at the Asheville, N. C., tannery of Hans Rees' Sons, Inc., it would be well to have an idea of the scope in the United States of this particular branch of the leather industry. Data recently published by the Bureau of the Census disclose that leather-belting manufacturers turned out in 1929 a total of 11,394,005 pounds of flat belting, valued at $19,552,612; and during the same period made other



Grinding chestnut-oak bark preparatory to making tanning liquors.



Top—Battery of steam-heated leaching vats in which the tannin is extracted from the chestnut wood and the chestnut-oak bark.

Circle—Compressed air being used to agitate lime solutions.

forms of leather belting to the aggregate value of $1,688,046. From similar leather, packing and other products were manufactured worth $6,629,825. Therefore, the entire output of the leather-belting industry amounted to a producer-value of $27,870,483 in 1929. There were 196 establishments engaged in the business.

Hans Rees came to the United States from Norway in 1835, and eleven years later started in the leather business with a brother-in-law, Joseph B. Hoyt. Subsequently the partnership was dissolved and Hans Rees continued alone in the business. Still later, two of his sons became partners in the enterprise; and upon their father's retirement in 1874 they took charge. In 1901 the business of Hans Rees' Sons was incorporated, with Norman I. Rees as its first president. These particulars are mentioned merely to show how long the name has been identified with the leather industry, and as evidence of ripe experience.

The corporation specializes in the tanning and the finishing of belting leather for power transmission and in turning out such kindred products as hydraulic, harness, and strap leathers in which pliability and high tensile strength are essential. Only the prime part of a hide, known to the trade as a butt bend, is used in the manufacture of belting. The other parts—generally referred to as offal, and consisting of bellies, shoulders, and heads—are used by shoe manufacturers in making inner soles, counters, box toes, welting, and heeling. Tannery by-products are fleshings, which go into glue stock, and hair that is widely employed in the fabrication of insulating felts and carpets and as stuffing in upholstery.

Leather is leather because tannin is able to work a transformation in the raw or "green" hide—incidentally making the hide proof against putrefaction and imparting to it a number of desirable properties. As scientists and others are still uncertain how tannin brings about the changes, we need not bother ourselves with unprofitable speculation. Similarly, it will suffice for us to know that the actual chemical identity of tannin is undetermined, although the trade draws upon a variety of vegetable sources for its tannin. On the other hand, the tanner has definite knowledge about the skins he uses in producing his leather.

The skins of all vertebrate creatures are composed of four well-defined layers. The outer one, called the epidermis carries the hair and the hair roots; the second layer contains a network of nerves, small blood vessels, etc.; the third layer, the true skin or dermis, is largely composed of intimately interwoven fibers that spread in every direction; and the fourth or innermost layer is the fat-bearing tissue that lies immediately over the flesh. The fibrous true skin is the substance which forms the basis for leather; and it is only the best part of a hide that is utilized in making belting leather.

The tanner's problem is, therefore, to free a hide of its hair, to remove any attached flesh or fat, and, after tanning, to prepare the resulting leather for his special market. The hides handled at the Rees plant in Asheville are received from packing houses in Chicago, St. Louis, Omaha, Kansas City, New York, Baltimore, etc. They arrive in bundles, and are well salted to prevent putrefaction. Otherwise, they are just as they were stripped from the cattle, and decidedly dirty. No two hides from the same kind of animal are alike; and the tanner is continually confronted with the discovery that the hides he has bought and treated to a point have blemishes or defects that were unobserved before the hair was removed—in fact, could not be detected earlier.

As explained by Mr. Charles E. Rudd, first vice-president of the corporation and in charge of operations at Asheville: "Nature has strangely made one class of hides different from another. For example, steer hides are thick along the backbone—tapering off in thickness from thence around the body. A bull's hide is exactly the opposite, but has a very thick neck. A cowhide, on the other hand, is of fairly uniform thickness throughout. The fiber of a bull hide is long, coarse, and open; that of a cowhide is fine and closely knit; and that of a steer is a happy medium between the two. In nearly all parts of the country, from December to June, cattle are apt to be attacked by a grub which centers its harmful work upon the most valuable part of the hide along the backbone. Not infrequently these pests bore holes right through the animal's hide".

While tannin, as already mentioned, may be obtained from the wood of the quebracho tree, from wattle bark, mangrove bark, sumac leaves, divi divi pods, myrobalan nuts, etc.,

Hand operation of working to the surface and removing fine hair from limed hides.

1—Machine used to remove bulk of hair from limed hides. 2—"Laying away" partly tanned hides in finishing liquors. 3—Cutting up hides after they have been tanned. 4—Shaving off the last of the flesh still clinging to pieces of belting leather. 5—Stretching belting leather by the use of compressed air.

etc., still the character and the quantity of tannin that can be leached from domestic chestnut wood and chestnut-oak bark make these sources of tannin especially desirable for the high-grade leathers used in the belting industry. Indeed, it was because of the large local supply of these two raw stuffs, an abundance of excellent water, and good railroad facilities that the Rees interests established a plant in Asheville about 30 years ago.

Because of the part played by tannin in tanning hides, let us see how the chestnut wood and the chestnut-oak bark are first prepared in the Rees plant to facilitate the extraction of their contained tannin. This is done by grinding the wood and bark to a proper stage of fineness by mechanical means, and then moving the product by a power-driven conveyor to large wooden tanks in which it is steeped in hot water until virtually all the tannin has been extracted. For bark, there is a battery of these tanks—each 10 feet in diameter and 10 feet deep; and a charge consists of substantially 8 tons of ground bark with sufficient water. For wood the tanks are 16 feet in diameter and 16 feet deep. The liquor is moved successively from the first to each of the other vats. This is done by air lifts which pump the stronger liquor from the bottom of one tank and discharge it into the top of the next one—thus gradually building it up to the ultimate desired strength. During this progressive process the temperature of the liquor in each tank is maintained at 175° F. Before the liquor comes in contact with the hides it is agitated with compressed air to cool it so that it will not hurt the hides. After the liquor is thus made, it is drawn into the grading tanks in the tan yard where a blend of liquors is thoroughly mixed by means of compressed air. The water used in the plant is obtained from a nearby river and also from three wells having an average depth of 200 feet. From the wells the water is brought to the surface by means of air lifts.

1—The old and dependable process of hand-stuffing belting leather. 2—Measuring machine that quickly calculates the area of any piece of leather run through it. 3—Sorting belting leather and making it ready for shipping.

Now for the actual processes by which the green hides are tanned and made into the kinds of leather for which the Asheville plant is widely known. After unbundling, the hides are laid flat in piles of 100 or more, tied together, and conveyed by machinery to vats containing cold water. There they remain in soak for one or two days to free them of salt, dry blood, and dirt. When so cleaned and softened, the hides are removed from the vats and conveyed to other vats containing a mixture of lime and water—the liquor being agitated from time to time with jets of compressed air. The hides are transferred daily for a number of days from one vat to another —the strength and the character of the liquor being the same in each vat. Liming serves to kill bacteria, to loosen the hair, and to plump the hides so that they will be just that much more receptive to the penetration of the tanning liquors when placed in the tanning vats.

Upon leaving the last of the liming liquors, the hides are put through several machines. The first removes the major portion of the hair; the next gets rid of most of the flesh; while still another machine takes off much of the fine hair—the remainder finally being scraped off by hand. These operations remove the greater part of the lime liquors which, in themselves, retard tanning. The hides are then inspected for defects that are not readily discernible when the hair and the flesh are on them. This preparatory work takes about twelve to thirteen days, and then actual tanning begins.

The hides, now hung on vertical sticks, are suspended in a vat containing a weak tanning liquor, and each day thereafter, for a series of days, the hides are shifted to succeeding vats—each following vat holding liquor slightly stronger than the preceding one. The purpose of this is to obtain the basic color and to maintain the plumpness obtained during liming. It is an important operation, for if the liquors are too weak the plumpness falls away and if too strong the pores are sealed, subsequently preventing proper penetration of the tanning liquors.

After leaving the last of the tanning vats in which the hides are hung, then they are laid flat, one on another and in lots of about

100, in vats containing still stronger tanning liquors. Each hide is separated from the succeeding hide by a layer of finely ground bark which serves to permit the tanning liquor to reach every part of every hide. After a time, the hides are taken out of these vats, stronger liquor is put in them, and the hides are returned to the vats for another period of soaking. This "layaway" procedure is continued until the tanning cycle is completed—the layaway operations covering a total period ranging from 60 days to 120 days on special leathers—depending upon the character of the hides and the quality of the leather desired. This modern method of tanning does in the course of a number of weeks what used to require an interval of from one or more years when the industry was practiced in a simple way in many villages and small towns.

After the hides are tanned they are cut up into various parts suitable for the trade's requirements. The offal before mentioned is finished by itself. The choice parts of the hides go for belting leather. Leather for belting now has the remaining flesh shaved off. Then it is washed, or rather scoured on both sides with warm water, and bleached—soda, sulphuric acid, and sumac being used with water for this purpose.

"Belting leather, says Mr. Rudd, though sold by the pound, must not weigh too much per square foot, that is, the fibers must not carry too much tannin because it would make the leather brittle and apt to break after a short while in service. Enough space should be left around the fibers for the reception of grease applied in the finishing process. Every fiber of a belt should be well lubricated to offset friction among the fibers; and therefore a lubricant is put in the leather to prevent service friction from heating and burning. This process is called 'stuffing'.

"In this connection it might be added that many users of belting pay little attention to it while it is in use. The fibers of leather, working back and forth as the power load decreases and increases, must be lubricated the same as any operating part of a machine. An occasional light dressing of neat's-foot or codfish oil will greatly prolong the life of a leather belt, just as the lubrication of a bearing will do for a machine. A belt is an integral part of a machine, and it should be oiled from time to time but not necessarily as often as the machine.

"When partly dry, the leather is coated on both sides with a mixture of cake tallow and pure Newfoundland codfish oil. The men that do this work are experts; and each section of a piece of leather calls for individual treatment. The life of a belt depends in large measure upon the way the stuffing is done. After the stuffing is finished, the leather is hung up to dry; and as the moisture evaporates the grease enters and takes its place and so envelopes the fibers. When this action ceases, the leather is dipped in warm water and any excess grease removed.

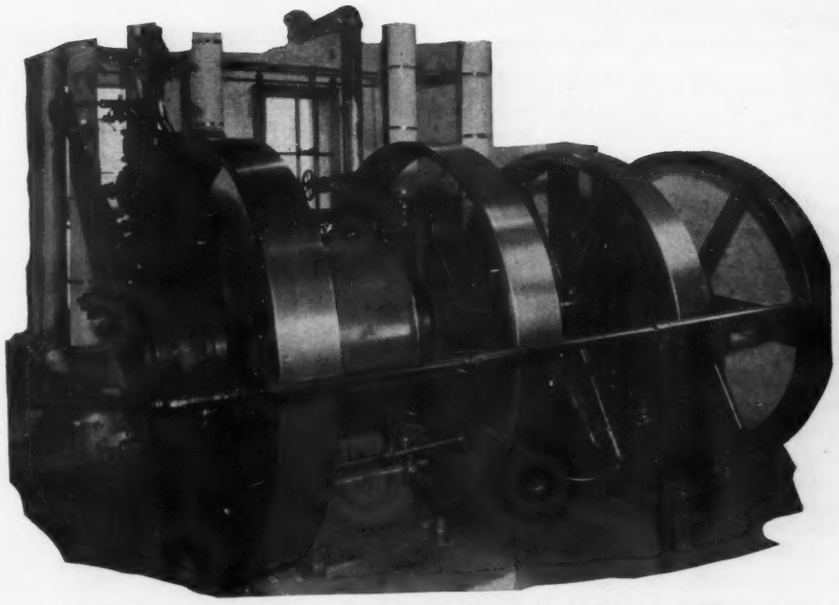
"The next step is to stretch each piece of leather by machine; and compressed air is used in this important operation. The leather stays in the stretching frames for 24 hours while drying; and thereafter the pieces will hold that stretch in service. The leather is then polished, sorted according to weight and quality, and prepared for shipment to the beltmaker. The beltmaker cuts the material into strips, tapers the ends so that the strips can be cemented together, and thus is able to produce belts of any required width and length".

A belting tanner is doing well if he gets 60 to 63 pounds of marketable leather out of every 100 pounds of raw hides. However, this situation is helped slightly by the sale of by-products. For instance, the flesh removed from hides is rendered into a low-grade grease; hide trimmings, such as ears and other parts, are sold to gluemakers; leather scraps are disposed of to fertilizer manufacturers; and the hair is bought by makers of insulating felt and by upholsterers.

The Asheville plant of Hans Rees' Sons, Inc., covers 22 acres, and is capable of handling 9,000,000 pounds of hide a year, representing 225 minimum carloads of leather. The working force numbers about 300. The largest hide ever tanned in this country was that of the big elephant Chief, and it was tanned by Hans Rees' Sons. The animal went wild in Troy, N. Y., and had to be killed. Its hide weighed 800 pounds, was 20 feet long from tip of trunk to end of tail, and 16 feet at its greatest width. The hide's tanned weight was 500 pounds, and it was 3 inches thick at its thickest part. It took three years to tan it!

The present officers of Hans Rees' Sons., Inc.. are: Harald B. Rees, president: Charles E. Rudd, first vice-president; Edward D. McKown, second vice-president; and E. F. Gordon, secretary and treasurer.

Something like $500,000 worth of rustless steel has been used for window trim and other decorative work on New York City's 85-story Empire State Building.



Two Class FR-1 steam-driven compressors that furnish air for various purposes in and about the tannery.

MACHINE SIMPLIFIES WORK OF TESTING CANS FOR LEAKS

TINS used for canning foodstuffs must be tight to prevent both leakage and the deterioration of the contained fruit, vegetable, fish, meat, or whatever else it may be. Everyone of the millions of cans produced annually for this purpose is, therefore, tested for soundness before it leaves the factory. For this work there has lately been provided a machine that makes it possible quickly to detect and to reject any tin that does not meet requirements.

The machine operates automatically, and tests the cans under air pressure. Its main feature is a wheel with many spokes that is kept revolving continuously and, in its travel, carries the containers, one after another, through a tank filled with water. Each can, as it arrives by way of a chute, is clamped to the rim between an adjustable cast-iron plate and a rubber disk and, with its fellows, is filled with compressed air before immersion. If a tin be leaky, the air will escape, and, upon reaching the water, cause tell-tale bubbles to rise to the surface. These are a sign to the inspector that the can then in the bath is faulty, and he promptly raises a lever that discharges it from the machine and removes it by a separate chute. The apparatus can be adjusted to take cans up to 4½ inches in diameter and 6 inches high.

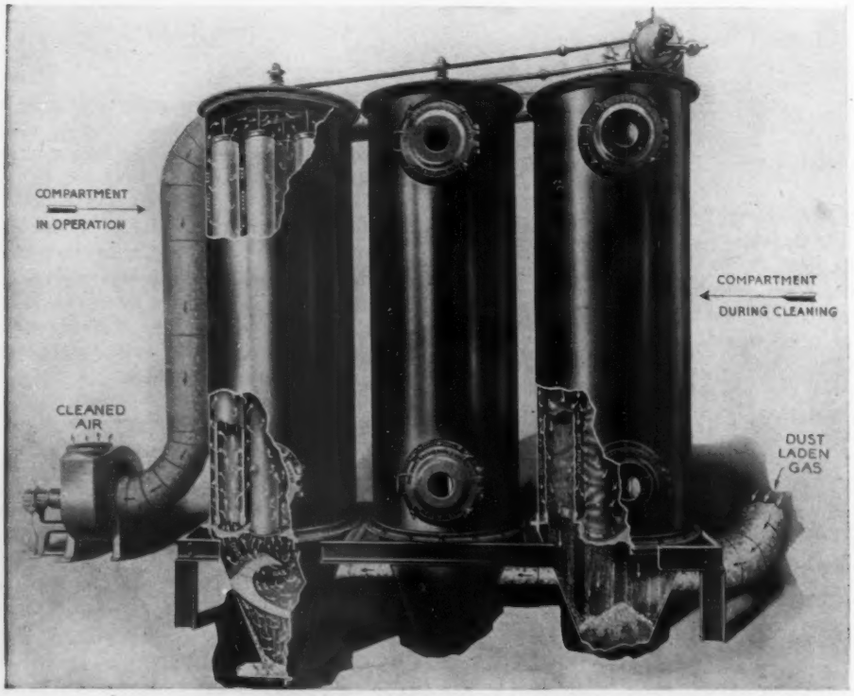
Following the installation of a refuse-burning steam plant, a Huddersfield, England, corporation expects to save about $500 a week on fuel. The steam so raised is passed on to an adjoining power house where it serves to generate electricity, while the by-product or clinker is used in roadbuilding. The refuse-disposal plant was built at a cost of approximately $325,000, and since it has been in operation has obviated the burning of 3,095 tons of coal.

COMPRESSED AIR CLEANS FILTERS OF DUST-COLLECTOR SYSTEM

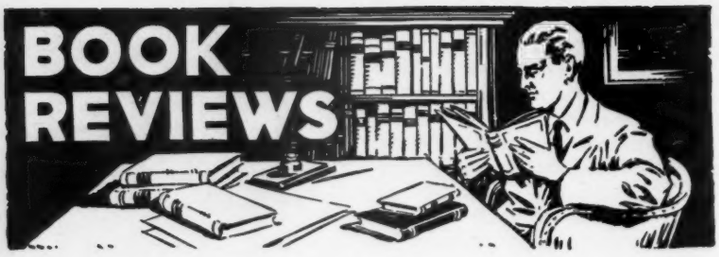
HAVE you ever seen a battery of tanks in a dusty factory and wondered what they were for? They were probably part of an automatic dust collector including filter bags, exhaust fan, dust hoppers, and a pneumatic actuating mechanism consisting of an air distributor, a ¼-hp. motor, a shaking piston, a damper, and a device that controls the frequency of the shaking periods.

All the filter bags in each compartment are hung from a framework which is attached to the center shaft of the shaking piston. The distributing valve supplies compressed air to each filter compartment in rotation. The air pressure closes the damper which cuts the compartment in operation off the line and at the same time actuates the shaking piston. This loosens the dirt collected on the inside of the filter bags. Coincident with shaking, a small amount of atmospheric air is admitted at the top, causing air to flow through the bags in the opposite direction. This air carries down into the hopper the dirt that has been loosened from the filter cloth. The operation lasts from two to four seconds.

In the case of the control mechanism mounted on the right-hand tank of the dust collector illustrated, the air-distributing valve is direct connected to the electric motor through a speed reducer. A gate valve in the line is actuated by an adjustable cam so that the length of time between shaking periods can be varied from two minutes to an hour. Should it become necessary to change one or more bags in a compartment, that particular compartment is cut off the circuit by closing the air-supply valve—the rest of the units temporarily proceeding to function independently of the compartment being serviced.



Automatic dust-collecting system showing the cleaning of some of the filter bags by the air-operated mechanism.



TRENDS IN THE FOREIGN TRADE OF THE UNITED STATES. A book of 329 pages, published by the National Industrial Conference Board, Inc., New York City. Price, $3.50.

MOST of us know that the United States has come to occupy a new position in international affairs since the conclusion of the World War, but it is doubtful if more than a comparatively small percentage of us have any clear idea what this position actually is and what it implies. Appreciating this, the National Industrial Conference Board, Inc., has set itself the task of spreading a better understanding of our international position and its consequences so far as they concern the internal economic life of the nation. The present volume is a well-ordered exposition of our trade expansion and its significance. Statements are convincingly reinforced with authentic statistics.

A TEXTBOOK OF GLASS TECHNOLOGY, by F. W. Hodkin and A. Cousen. A copiously illustrated volume of 551 pages, published by Constable & Company, Ltd., London, and obtainable in the United States from Glass Industry Publishing Company, New York City. Price, $12.00.

THE manufacture of glass is one of the most ancient of surviving industries and, undoubtedly, one of the most interesting. For a long time, the art of making glass was largely empirical, which explains the wide differences in the degrees of success obtained by workers of the same period in different parts of the world; and, for the same reason, we find the art outstanding at one time and noticeably decadent later on. Today, the making of glass of various kinds and for many purposes is no longer the outcome of chance and mere rule-of-thumb practices—it is the consequence of a more or less complex technology. How intricate or how diversified this technology is can be quickly gathered by even a cursory glance over the pages of this excellent work. To the uninitiated, glass acquires a new significance after reading this book.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION FOR 1929. An illustrated volume of 622 pages, published by the United States Government Printing Office and obtainable from the Superintendent of Documents, Washington, D. C. Price, $1.75.

THIS publication is always interesting, especially because of the general appendix in which can be found numerous articles that are usually written in a way understandable to the so-called average citizen. The present volume is no exception in this respect; and it contains, among other topic matter, articles having to do with the physics of the universe, the work of counting the stars, a paper on the nature of light, the evolution of the art of producing artificial cold, the mystery of life, the Gulf Stream, how insects fly, mechanical transport, the aborigines of Hispaniola, the sewing machine, etc., etc.

A HANDBOOK OF ENGLISH IN ENGINEERING USAGE, by A. C. Howell, Associate Professor of English, University of North Carolina. A book of 308 pages, published by John Wiley & Sons, Inc., New York City. Price, $2.50.

IN his preface, the author states: "It is time to face squarely the fact that for the majority of engineers English is primarily a tool for advancement in their profession". Just as the engineer has recourse to one or the other of several handbooks, so this volume has been designed to aid him in his use of English. It is admittedly a tool, and, therefore, in order that it may be truly serviceable, is arranged with an eye to clarity, accuracy, and utility. No one will deny that most engineers have need of much improvement in their English; and this is conspicuously evidenced in the letters, reports, and professional papers written by them.

Clean Dry Air is the title of Bulletin 158 issued by the Centrifix Corporation, 3029 Prospect Avenue, Cleveland, Ohio. This bulletin, which will be sent gratis to any interested person or concern, describes in general terms the continually growing need for clean and dry air in many departments of industry. The publication also describes the virtues of the apparatus built for this service by the company in question.

Progress *in* Mining

T*he* First White Man *to* Mine Lead *in America*

When the Sauk and Fox Indians in 1788 gave permission to Julien Dubuque, an Indian trader, to work the Illinois lead mines which they had operated for centuries, Dubuque gained historical significance as the first white man to mine lead in America.

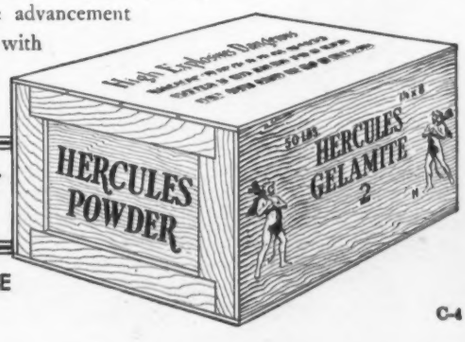
AMERICA'S mines in 1928 produced 627,000 tons of lead ore, valued at $72,000,000—a development which would have been impossible without modern explosives, scientifically used.

In the country's pioneer days, dynamite was unknown. About 1860, came the first crude dynamites, which, though haphazardly used, sufficed until keener competition necessitated lower mining costs. Then arose the demand for better explosives and better ways of using them—*the demand for explosives research.*

For example, when it was apparent that large scale operations were necessary for economical production, explosives research improved the gelatins so that their fumes were satisfactory for underground use.

Spurred by the desire for greater value in explosives of the gelatin type, Hercules research brought forth the Gelamites which are far more economical than the gelatins and can replace gelatin satisfactorily under most conditions. With greater explosives values like this have come better methods of drilling and placing charges with the result that mining costs today are being lowered to a point undreamed of a few years ago.

Constant research for better explosives values; insistence on high quality; accurate control in manufacture; exhaustive field tests of new explosives; and advisory service to assist in determining the best methods of application—these are features of Hercules explosives and service that assure full, honest value today and portend future advancement in keeping with mining progress.



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WILLIAM LAWRENCE SAUNDERS, *President*
G. W. MORRISON, *Treasurer*
ROBERT G. SKERRETT, *Editor*
FRANK RICHARDS, *Associate Editor*
JOSEPH W. SHARP, *Secretary*

LINWOOD H. GEYER, *European Correspondent*, *147 Leadenhall Street, London, E. C. 4*
F. A. MCLEAN, *Canadian Correspondent*, *10 Phillips Square, Montreal, Canada*

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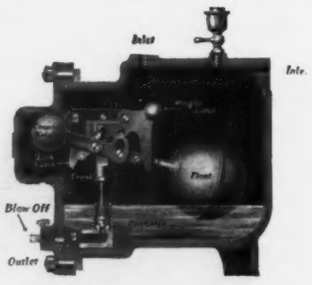

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Bulletin 528-A.

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